Technology Review

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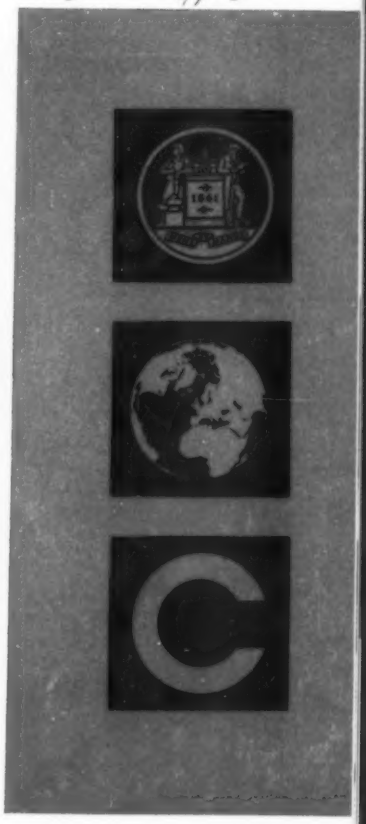
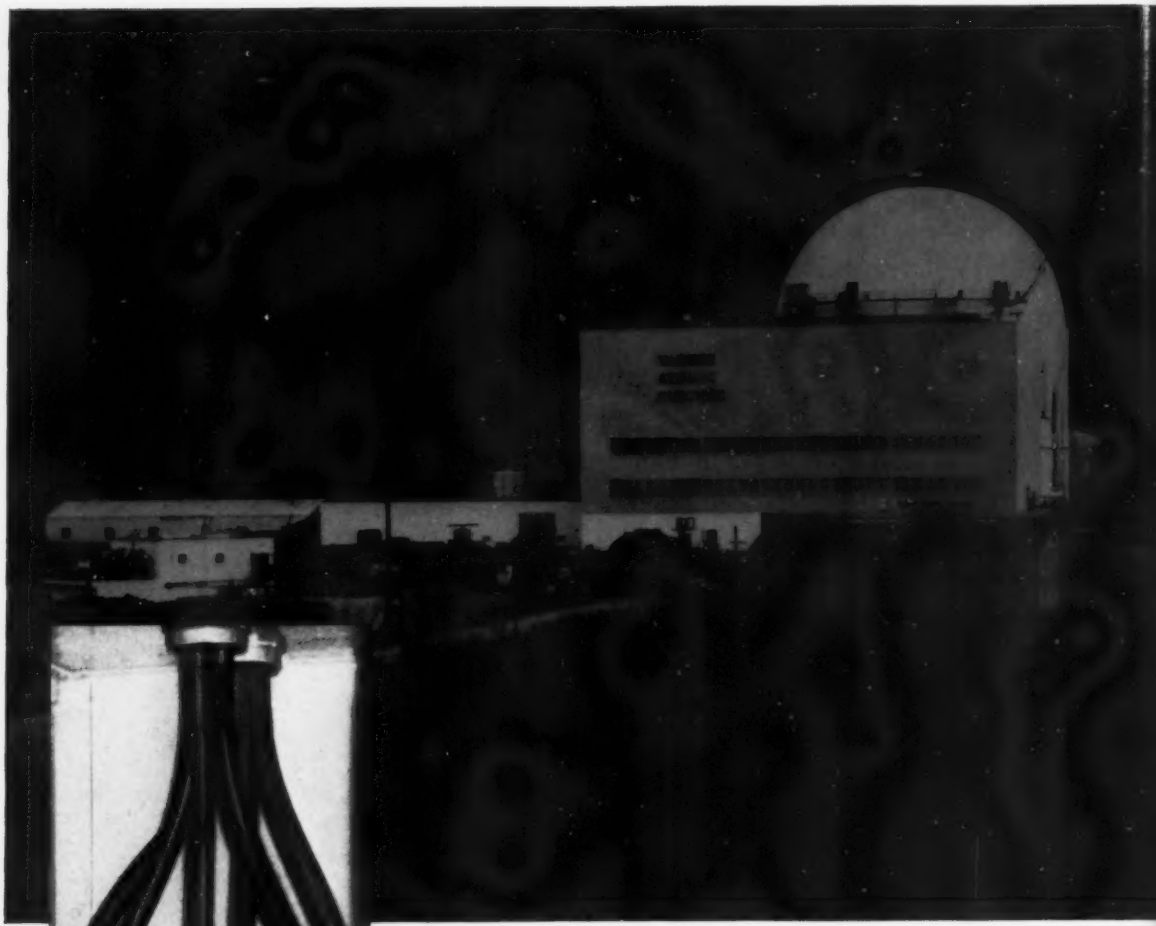
TECHNOLOGY
DEPARTMENT

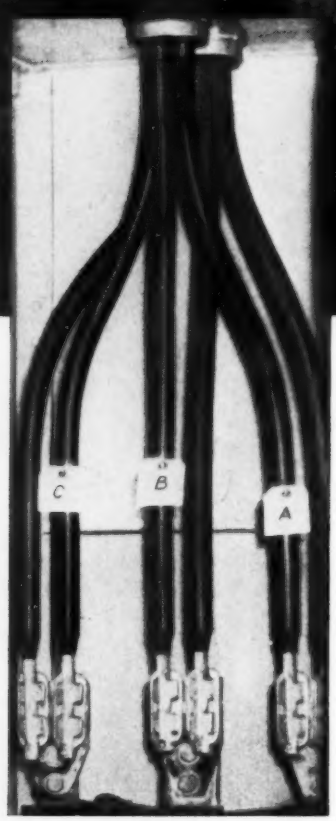
vol 63. #8.



M.I.T.'s Centennial Celebration

JUNE 1961: President Stratton's Address at the Convocation. Page 33





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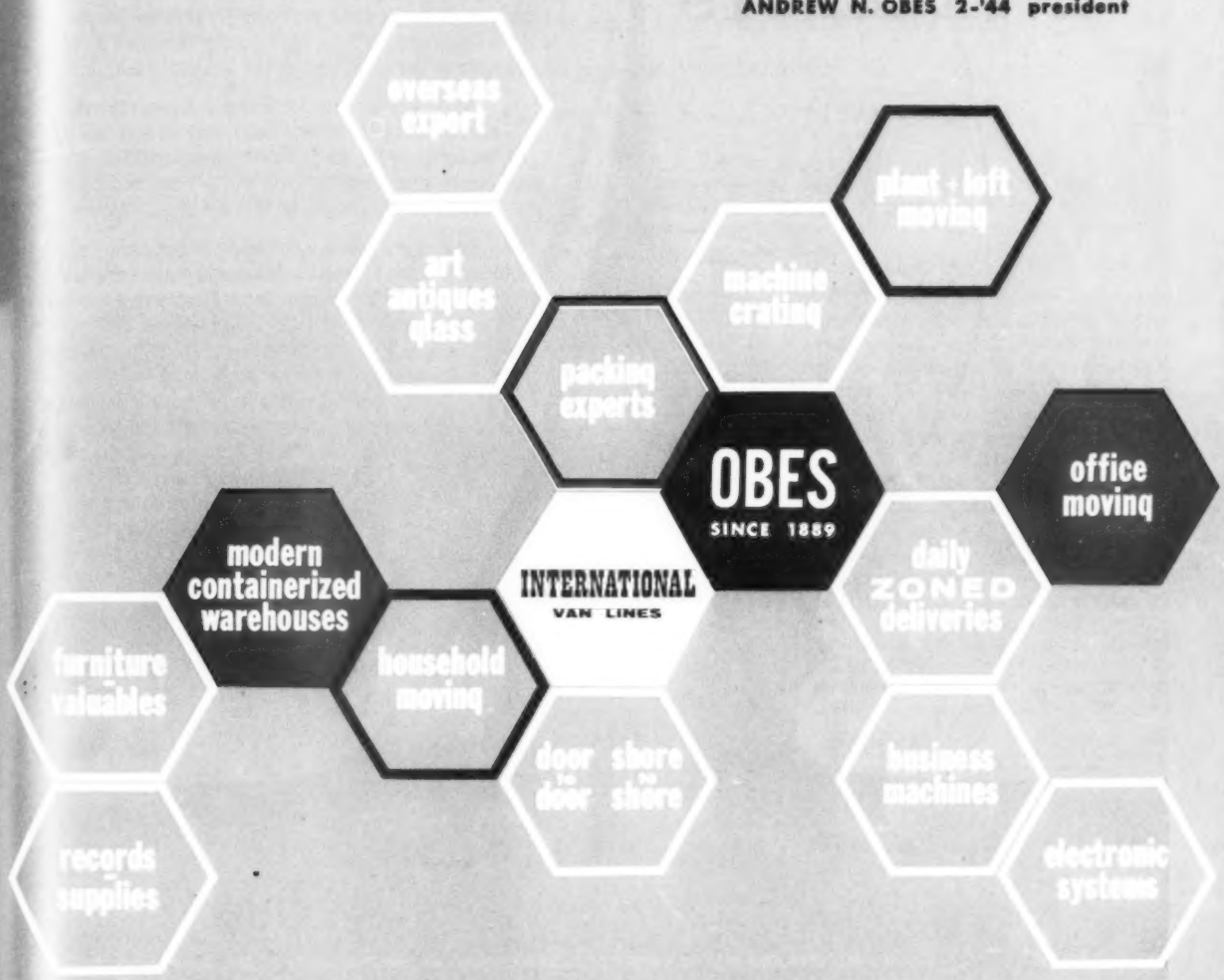

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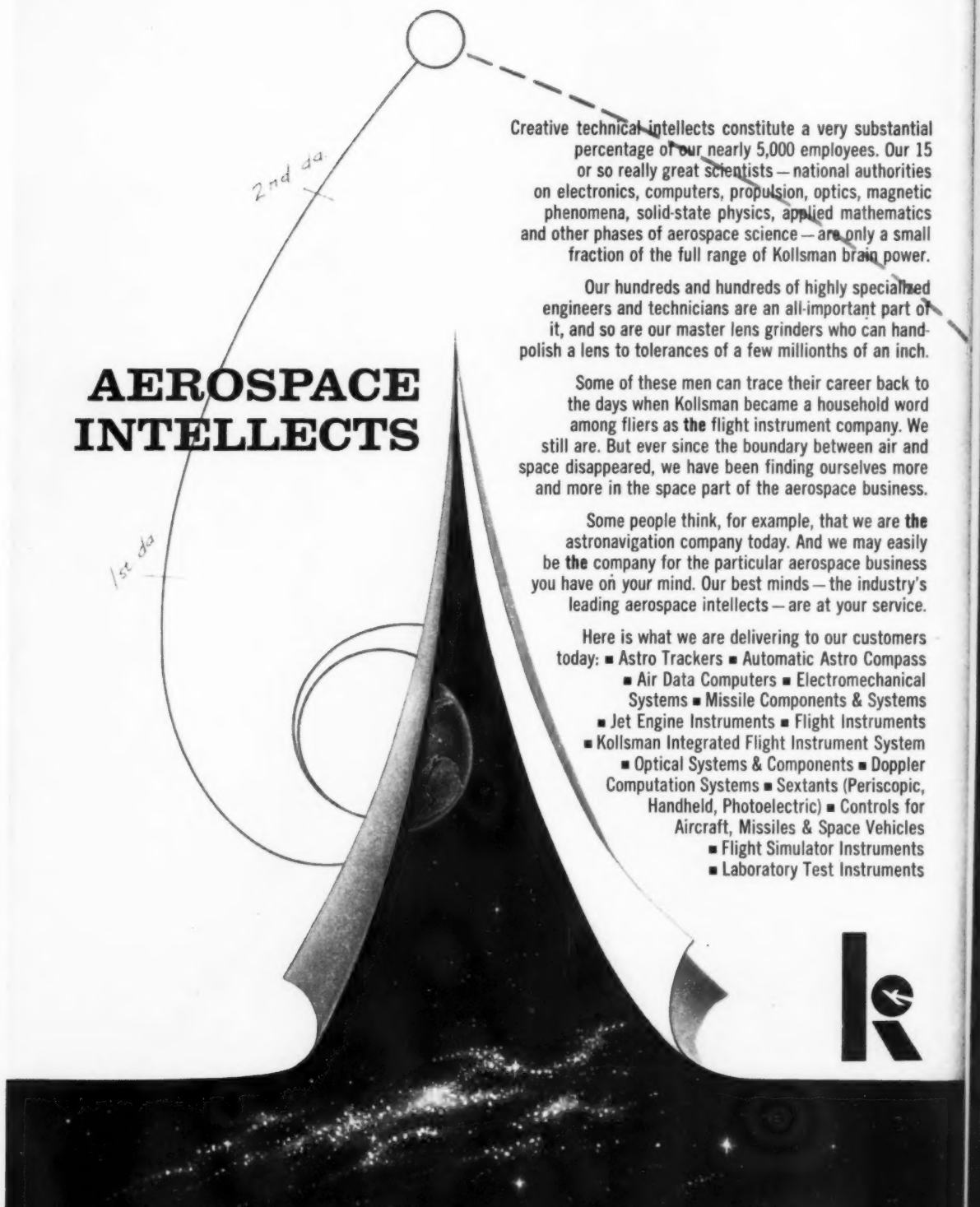

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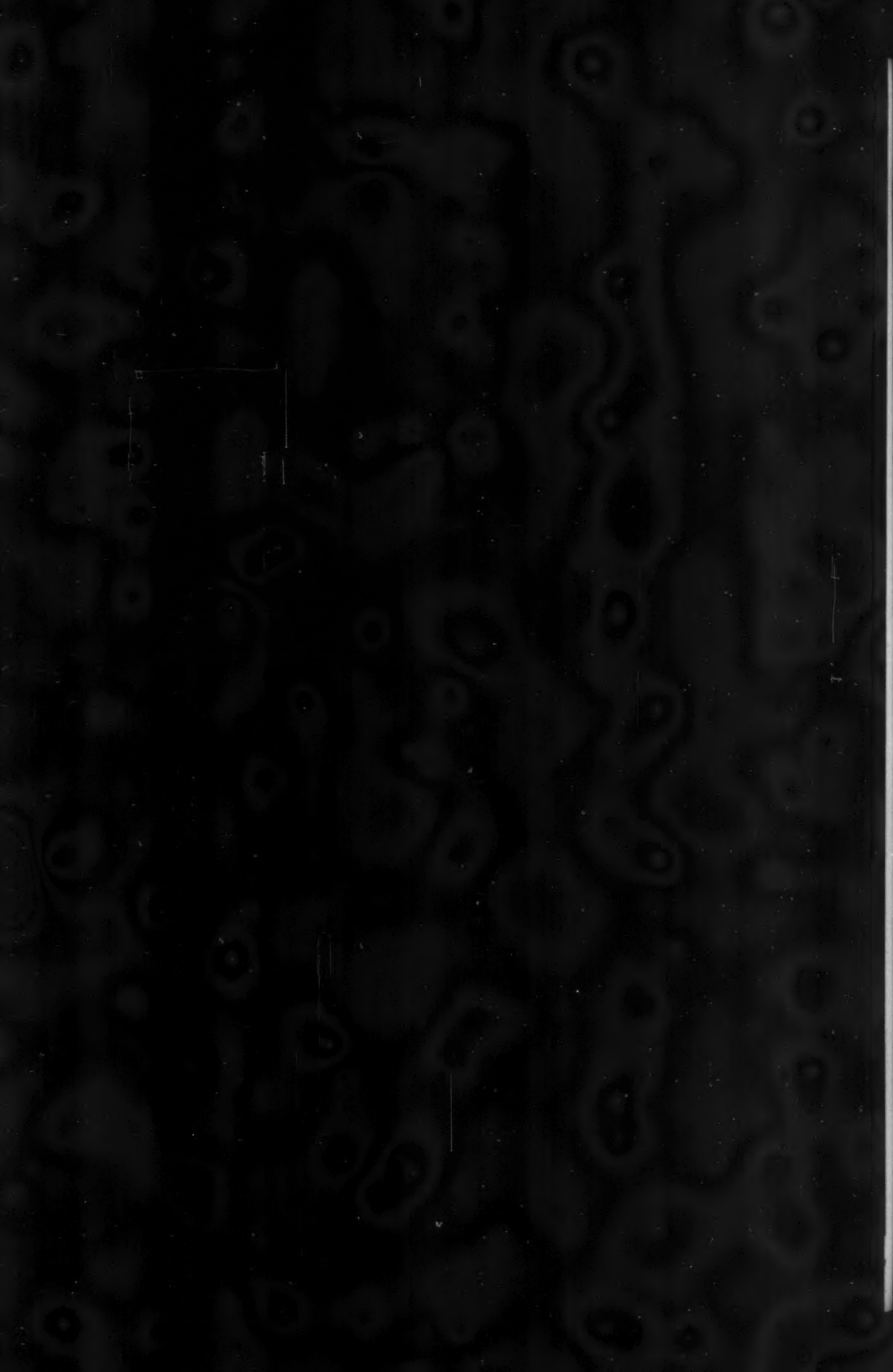

Technology Review

Reg. U.S. Pat. Off.

Volume 63, Number 8 *Edited at the Massachusetts Institute of Technology* *June, 1961*

Feedback

ADDERS to ATTERS

FROM R. E. MICHAUD, '47:

We at Computer Control Company were pleased to see the Lincoln Laboratory ADDERS and their applications described in the April issue. These units, in both Mark I and Mark II versions, were designed and constructed by Computer Control Company to Lincoln Laboratory specifications, using 3C standard products.

It is interesting to note that the Mark I ADDERS shown in your photograph have been returned to 3C for conversion to a new logical configuration. Using the same solid state digital modules, these units will henceforth function as Automatic Teletype Error Recorders (ATTERS).

Framingham, Mass.

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Centennial pictures on the cover show the architectural exhibit, the academic procession, Dr. J. Robert Oppenheimer participating in a panel discussion, Dr. and Mrs. Stratton at the Faculty's party, Prime Minister Macmillan speaking, and students en route to Sturbridge Village for their celebration.

THE NEW HEAD of M.I.T.'s Department of Nutrition, Food Science, and Technology, Dr. Nevin S. Scrimshaw, is shown here participating in a health survey as part of his recent work with INCAP (the Institute of Nutrition of Central America and Panama). The circle on the throat means goiter, a grave health problem in INCAP's six-member countries.

PHOTOGRAPHS in this issue were provided by the M.I.T. Photo Service and INCAP (at left), Phokian Karas (Cover and pages 40, 43, 45 and 47), Curtiss D. Wiler, '63 (Cover and page 29), Robert E. Schildkraut, '62 (Cover), Conrad E. Grundlehner, '64 (Cover), Philip Lieberman (page 39), and J. Frederick Laval (page 31).

EDITOR: Volta Torrey; BUSINESS MANAGER: R. T. Jope, '28; CIRCULATION MANAGER: D. P. Severance, '38; EDITORIAL ASSOCIATES: J. J. Rowlands, Francis E. Wylie, John I. Mattill; EDITORIAL STAFF: Ruth King, Muriel R. Roberts, Pauline Gates; BUSINESS STAFF: Madeline R. McCormick, Marianne G. Hagerty; PUBLISHER: H. E. Lobdell, '17.

The Technology Review is published monthly from November to July inclusive, on the 27th day of the month preceding the date of issue, by the Alumni Association of M.I.T.; Clarence L. A. Wynd, '27, President; H. E. Lobdell, '17, Executive Vice-president; Thomas F. Creamer, '40, William L. Taggart, Jr., '27, Vice-presidents; Donald P. Severance, '38, Secretary-Treasurer.

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Second-class postage paid at Concord, N. H.

Individuals Noteworthy

Intelligence Monitor

THE CHAIRMAN of the M.I.T. Corporation, James R. Killian, Jr., '26, has been made chairman of the President's Board of Consultants on Foreign Intelligence Activities.

This board was created by President Eisenhower and Dr. Killian served as its first chairman from 1956 to 1958. He also was President Eisenhower's first scientific adviser. President Kennedy reappointed Dr. Killian to the intelligence board.

Commencement Speaker

FRANK STANTON, President of the Columbia Broadcasting System since 1946, will give the principal address when M.I.T.'s Class of 1961 is graduated on Friday, June 9.

Dr. Stanton was educated at Ohio Wesleyan and Ohio State Universities, and was an instructor in psychology at Ohio State before joining the research staff of the broadcasting system in 1935. He served CBS as research director, advertising director, and vice-president before becoming president.

Dr. Stanton is also a trustee of the Rand Corporation, a director of the New York Life Insurance Company, and has numerous other business and professional affiliations. He is a Fellow of the American Psychological Association and chairman of the Center for Advanced Study in the Behavioral Sciences.

The Election Results

AS ITS PRESIDENT for 1961-1962, the M.I.T. Alumni Association has elected *D. Reid Weedon, Jr., '41,* and as Vice-president, *Carroll L. Wilson, '32.* Two-year terms on the Executive Committee will be served by *Samuel A. Groves, '34,* and *Edward O. Vetter, '42.*

The nominees this year for Alumni Term Membership on the M.I.T. Corporation are John R. Kimberly, '26, Robert B. Semple, '32, and William B. Bergen, '37.

Alumni elected to the National Nominating Committee are: District 1, *Gilbert M. Roddy, '31;* District 2, *Robert T. Dawes, '26;* District 4, *John H. Holton, '17,* and District 5, *Joseph Wenick, '21.*

New Posts

NAMED in the news recently were the Alumni whose elections, promotions, and appointments follow:

Henry W. Hills, '20, Leo J. Myskowski, '28, and *Arthur Y. Taylor, '46,* as Directors, and *Thomas A. O'Brien, '38,* as Assistant Treasurer, Jackson & Moreland, Inc. . . . *Frederick O. A. Almquist, '23,* as Head of the Sanitary Engineering Division, Connecticut State Health Department . . . *Sargent D. Heath, '24,* as a Director, Washburn Company, Worcester, Mass.;

Kenneth T. Bainbridge, '25, as George Yasmer Leverett Professor of Physics, Harvard University . . . *Garvin A. Drew, '25,* as President, A. Schrader's Sons, Inc., Brooklyn, N.Y. . . . *Eben B. Haskell, '26,* as Assistant Vice-president, United Illuminating Company, New Haven, Conn. . . . *M. B. McDavitt, '26,* as Vice-president, Bell Telephone Laboratories, New York . . . *Gordon S. Brown, '31,* as a Director, Gorham Manufacturing Company;

Victor J. Duplin, Jr., '31, as Vice-president, American Ceramic Society . . . *Howard L. Richardson, '31,* as President, The Stanley Works, New Britain, Conn. . . . *Philip A. Coleman, '33,* as a Director, the Bristol Brass Corporation, Bristol, Conn. . . . *Frank R. Milliken, '34,* as President and Chief Executive Officer, Kennecott Copper Corporation;

D. Kenneth Finlayson, '35, as Vice-president, Sales, Scientific Design Company, Inc. . . . *Charles R. Holman, '36,* as Vice-president, Manufacturing, Paint and Brush Division, Pittsburgh Plate Glass Company . . . *Webster H. Wilson, '36,* as President, Hazeltine Electric Corporation, Little Neck, N.Y.;

Alfred E. Busch, '37, as President, Keuffel & Esser Company, Hoboken, N.J. . . . *Charles R. Kahn, Jr., '37,* as President, Wyant Conditioning Corporation, New York . . . *Paul R. DesJardins, '38,*

SIR JOHN COCKCROFT received the Atoms for Peace Award from James R. Killian, Jr., '26 (at right) in the Kresge Auditorium during M.I.T.'s Centennial Week.

as Manager, Engineering Planning, Worthington Corporation . . . *Joseph A. Bergantz, '41,* as Dean of Chemical Engineering, the University of Buffalo;

David B. Nichinson, '42, as President, Kollsman Instrument Corporation . . . *William G. Abbott, 3d, '44,* as Manager of Industrial Engineering, Ensign-Bickford Company, Simsbury, Conn. . . . *Thomas Y. Carmody, '44,* as Sales Manager, Union Carbide Olefins Company, Division of Union Carbide Corporation;

Walter E. Kulesa, '45, as Merchandising Manager, Delco-Remy Division, General Motors Corporation . . . *Robert B. Davis, '46,* as Mathematics Coordinator, Faculty of Webster College, St. Louis, Mo. . . . *Roger P. Sonnabend, '46,* as national President, the Young Presidents' Organization, for 1961 . . . *George E. Brown, '48,* as Parts and Service Manager, Renault, Inc.;

Cornelius L. Hudak, '48, as General Sales Manager, Plume & Atwood Manufacturing Company, Thomaston, Conn. . . . *John H. Hughes, '48,* as Assistant Vice-president, American Mutual Liability Insurance Company . . . *Sidney C. Howell, '49,* as General Sales Manager, General Products, The Weatherhead Company, Cleveland . . . *Norman B. Champ, Jr., '50,* as Vice-president, the Crane Company.

(Continued on page 6)

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Individuals Noteworthy

(Continued from page 4)

Honors to Alumni

MEDALISTS and recent recipients of other distinctions include:

Flemmon P. Hall, '21, Honorary Membership in The American Ceramic Society . . . *Nathan Cherniack, '22,* the Howard S. Cullman Distinguished Service Medal of the New York Port Authority . . . *Robert J. Hull, '23,* an award for leadership in water pollution control, by the Ministry of Energy Resources, Province of Ontario;

Julius A. Stratton, '23, the Faraday Medal of the British Institution of Electrical Engineers . . . *Anatole R. Gruehr, '24,* the 1961 Honor Award of the Kings County Chapter, New York State Society of Professional Engineers . . . *Richard H. Pough, '26,* the Frances K. Hutchinson Medal for service in conservation, by the Garden Club of America . . . *Howard W. R. Biers, '27,* Honorary Vice-presidency of the Iron and Steel Institute, London . . . *Joseph D. Murphy, '29,* and *Eugene J. Mackey, '39,* the 1961 R. S. Reynolds Memorial Award for architecture;

George Rosen, '37, the United Aircraft Corporation's George Mead Medal for engineering achievement . . . *Colonel Thomas J. Hayes, 3d, '39,* the Air Force Commendation Medal . . . *Robert M. Lerner, '59,* the 1961 Award for the Best Tutorial Paper at the National Electronics Conference, Chicago.

Robert Haslam: 1888-1961

A LIFE MEMBER of the M.I.T. Corporation and former Professor of Chemical Engineering, Robert T. Haslam, '11, died on April 4. He was a former Vice-president of the Standard Oil Company (N.J.).

Born in North Adams, Mass., Mr. Haslam joined the National Carbon Company in Cleveland after graduating from the Institute, but returned to Cambridge in 1920. He was in charge of the School of Chemical Engineering Practice, directed the Research Laboratory of Applied Chemistry, and initiated a course in gas and fuel engineering at the Institute.

In 1927 he became the leader of a group pioneering in petroleum synthesis for Standard Oil Develop-

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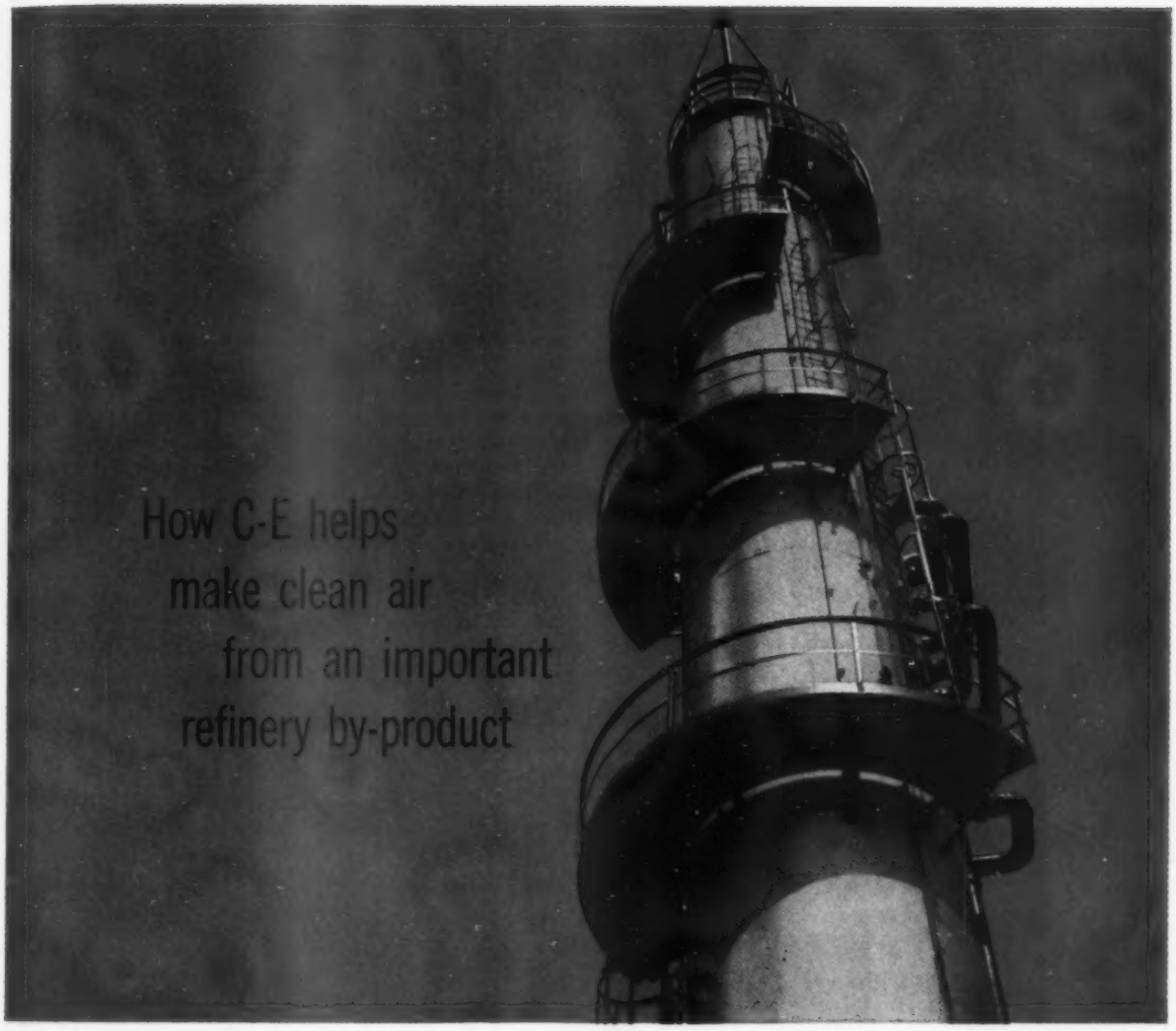
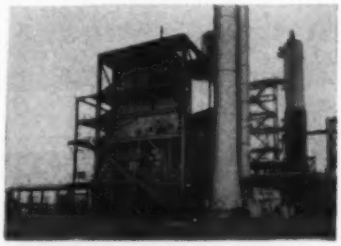


Many refineries use catalysts to "crack" crude oil into numerous petroleum products. But the catalysts eventually become poisoned and must be regenerated before they can be re-used. The regeneration process produces large quantities of hot, carbon-monoxide-bearing gas. Until recently, this gas—theoretically combustible—was discharged to the atmosphere because there existed no practical way to burn it.

Combustion Engineering, recognizing the concern with which refineries viewed this problem, directed the attention of its fuel experts and boiler designers to it. The result—C-E's CO Boiler. This efficient unit completely burns catalyst regenerator gas and discharges to the atmosphere carbon dioxide and water vapor, both normal atmospheric components. In addition, it generates large quantities of steam to help meet the refinery's process steam or power needs.

A formerly unusable marginal fuel is now doing productive work, and a contaminant has been removed from the air we all breathe. This advance in the disposal of industrial by-product waste is an example of how Combustion Engineering serves not only industrial America but the general public as well.



The C-E boiler pictured burns catalyst regenerator gas. This lean, hot, marginal fuel contains carbon monoxide which, when completely burned, generates sizeable quantities of steam for refinery use. The carbon monoxide is consumed in the boiler, preventing its discharge to atmosphere.

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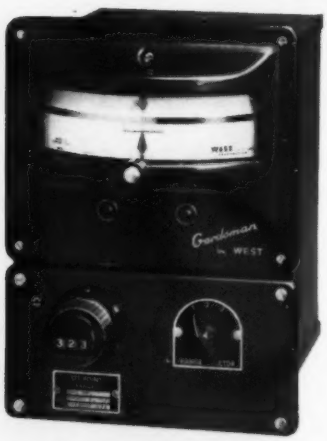

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Individuals Noteworthy

(Continued from page 6)

ment Company and four years later became the company's vice-president and general manager. He joined the parent Standard Oil Company in 1935 and served it as general sales manager, vice-president for two years, and as a director. He was also a vice-president of Hydro Engineering & Chemical Company, director of the Plantation Pipe Company, president of the U.S. Pipe Line Company, and a director of the American Gas & Electric Company, W. R. Grace & Company, Dewey & Almy Chemical Company, the Ethyl Corporation, and the Worthington Corporation.

He frequently contributed to technical and trade publications and, with Robert P. Russell, '22, wrote *Fuels and Combustion*. Mr. Haslam was a chevalier in the French National Legion of Honor, and a member of the U.S. Army Science Advisory Panel, the American Institute of Chemical Engineers, the American Petrological Institute, and other professional organizations. He first joined the M.I.T. Corporation as an alumni term member in 1949.

He is survived by his widow, Alice, and a son, Robert T. Haslam, Jr., '41.

(Concluded on page 78)

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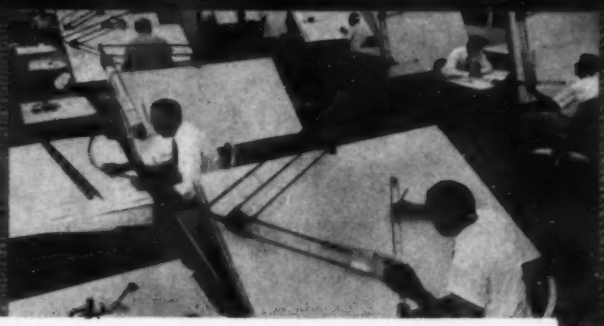

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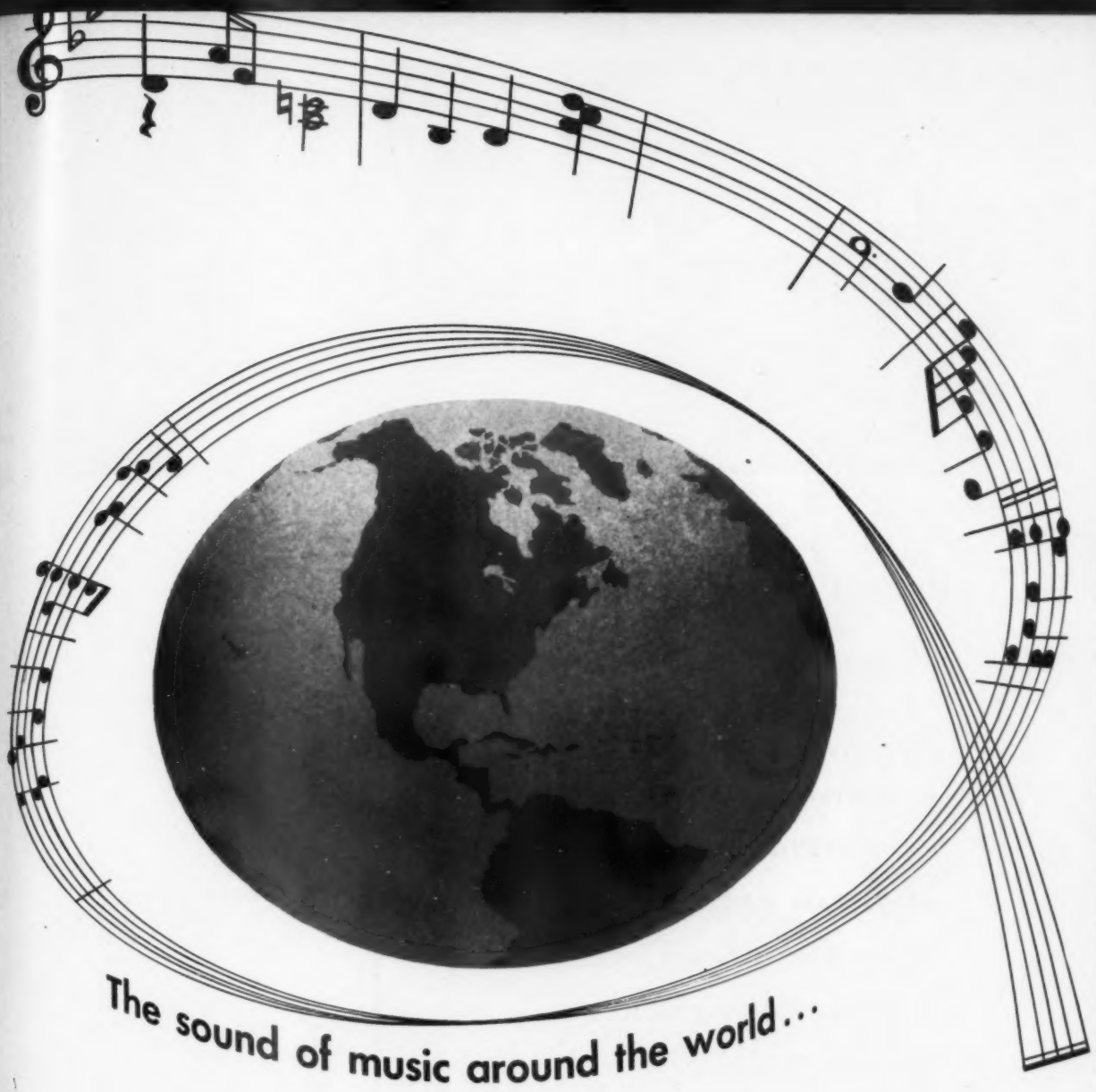

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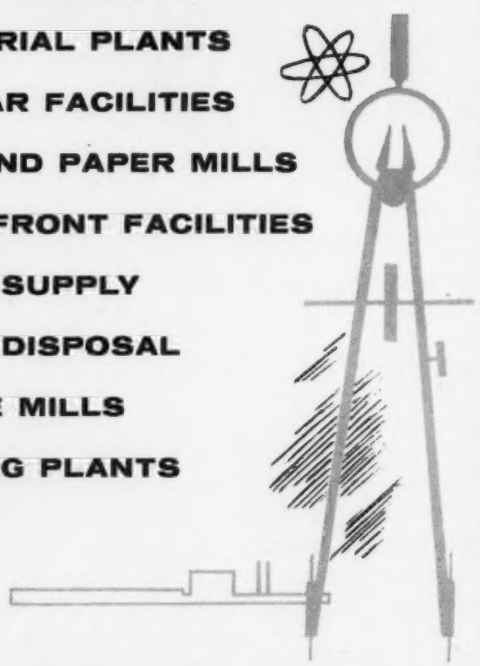

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Baumrucker, William, Jr.	1929
Billwiller, Charles J.	1955
Burton, Thomas M.	1934
Colburn, Robert T.	1923
Dannenberg, Warren B.	1936
Dickson, Arthur D.	1917
Eckberg, Adrian E.	1922
Ford, F. Leslie	1924
Greve, Einar	1953
Hare, Van Court M.	1923
Hodgdon, Richard T.	1933
Holzman, Lewis H.	1958
Johnson, E. Stanley	1932
Kimball, John	1907
Logan, Richard W.	1917
Lynch, John B.	1947
Marsh, Donald B.	1922
Marshall, Stanley S.	1950
Mormino, Paul S.	1935
Nelson, Percy L.	1947
Parker, Franklin P.	1936
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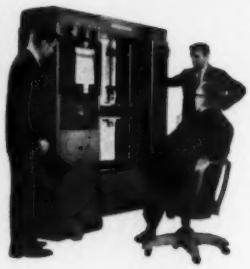

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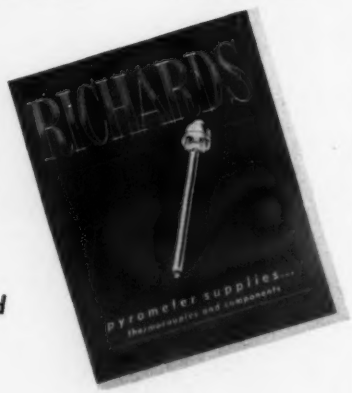

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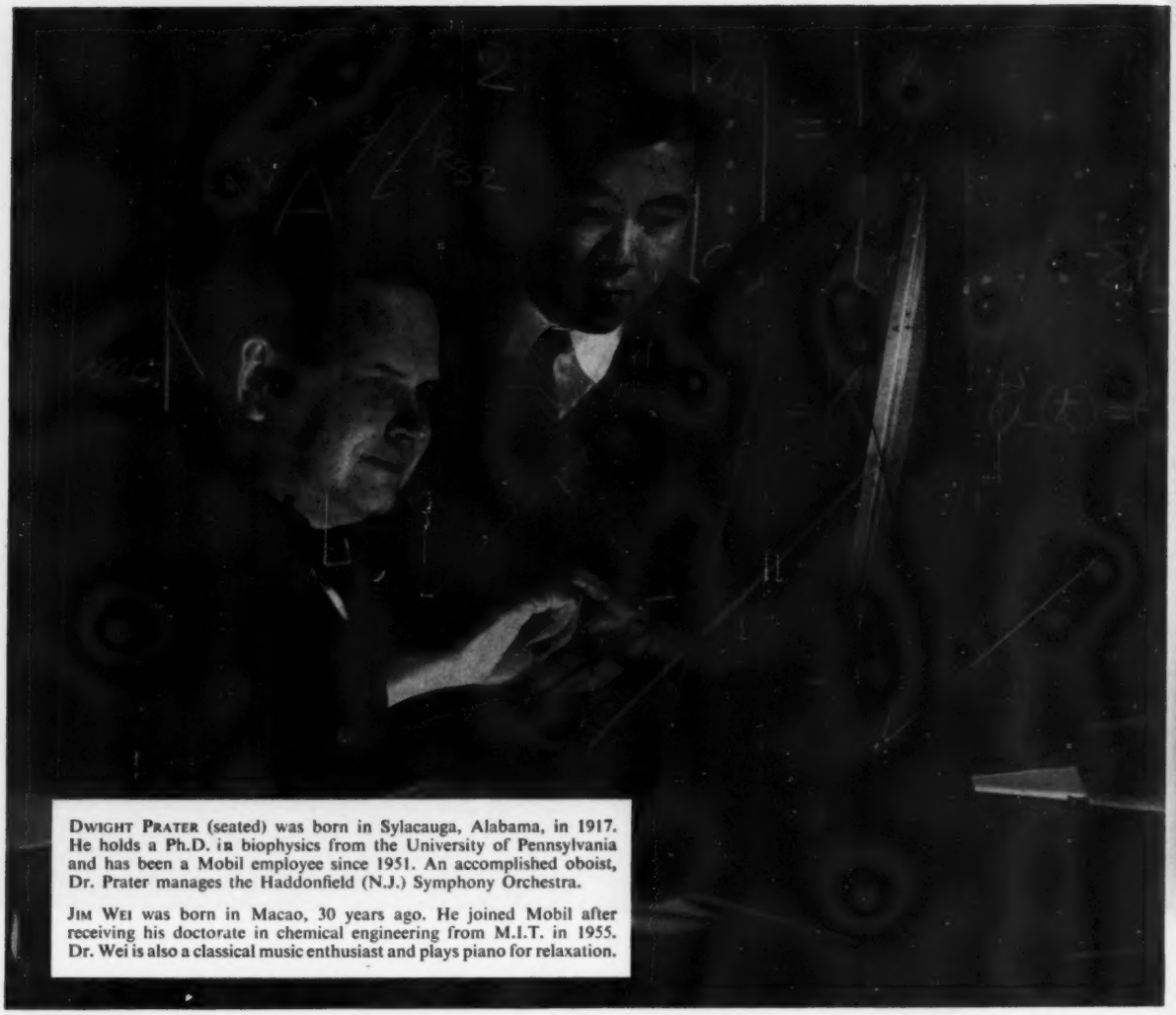

DWIGHT PRATER (seated) was born in Sylacauga, Alabama, in 1917. He holds a Ph.D. in biophysics from the University of Pennsylvania and has been a Mobil employee since 1951. An accomplished oboist, Dr. Prater manages the Haddonfield (N.J.) Symphony Orchestra.

JIM WEI was born in Macao, 30 years ago. He joined Mobil after receiving his doctorate in chemical engineering from M.I.T. in 1955. Dr. Wei is also a classical music enthusiast and plays piano for relaxation.

WHAT DOES A CHEMICAL REACTION LOOK LIKE?

A MATHEMATICAL MODEL of one is shown in this picture. The model represents a reaction that takes place in oil refineries every day.

Using an "off-beat" branch of mathematics, illustrated by this three-dimensional model, these Socony Mobil scientists have recently made an important breakthrough in the field of theoretical physics. They found a way to describe exactly what happens to petroleum molecules during refining. It formerly took hundreds of expensive laboratory experiments to get this information.

Their discovery allows Mobil to control chemical reactions with precision. As a result, we can now "freeze" refinery processes at exactly the proper stage to obtain maximum amounts of the products we want most. This means better products for Mobil customers.

These scientists have probed deeply and successfully into the foundations of petroleum reactions. The full implications of their breakthrough extend far beyond the specific problems of petroleum refining. Their work has given scientists everywhere greater insight and understanding into a fundamental process of nature.

Mobil encourages its scientists to give full play to their research interests and abilities. Dwight Prater points out that "our discovery was in a field in which neither one of us specialized at college."

Mobil scientists also are free to explore ideas which may appear to have little immediate application to the company's operations. Jim Wei notes, however, that "many of these investigations pay off handsomely later on—for the company and for us."

Dr. Prater and Dr. Wei are two of the 1,500 men and women engaged in Mobil's $25,000,000-a-year research program—in which imagination is turned into ideas, and ideas into better products and processes.

Like Jim Wei (above), class of '55, Mobil has dozens of M.I.T. graduates in positions of responsibility. We hope to have dozens more. From all of us at Mobil, best wishes to M.I.T. for its next hundred years.

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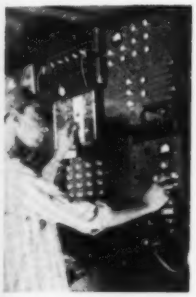

TO THE OCEAN'S FLOOR ... AND BELOW

Daily aboard TI's sea-going seismic and acoustic investigation centers —the SONIC, TEXIN and SEA SEARCH—geoscientists are studying and mapping the structure of the earth below the ocean's floor. Illustrated above is the seismic reflection method, with explosive charges detonated near the SONIC for detailed study of energy travel through water and rock. Shipboard technicians also record refracted seismic energy, measuring signals through the ocean floor from charges exploded on land or in water as much as 35 miles away. Similar land-based TI geophysical parties are now working in more than 22 countries of the world.

INNER-SPACE KNOWLEDGE FOR OUTER-SPACE TECHNOLOGY ADVANCED BY TI'S

scientific key to Davy Jones' locker!

At a time when the focus is on outer space — a time when we know more about the moon's surface than we know about 70% of the earth's surface — geophysicists such as this sea-going scientist from Texas Instruments are furthering space-age technology with studies of inner space — the oceans.

He represents one of more than 60 global TI geophysical investigation parties who are applying 30 years' experience in earth sciences to measurement of earth's land and sea physical characteristics. Fundamental to modern defense, earth sciences have extended their traditional role in petroleum exploration to gathering information vital to programs in *underwater warfare, missile accuracy, seismic communications, detection/surveillance of nuclear tests, and design of underground defense structures.*

TI's talent for these "down-to-earth" studies dates back to 1930, when the company was formed as Geophysical Service Inc. — the first independent company to perform seismic reflection surveys for oil exploration. And from GSI's early need for sensitive electronic seismic equipment came an engineering skill that was applied to Anti-Submarine Warfare systems in World War II, and resulted in TI's Apparatus division becoming a leading ASW equipment manufacturer today. This rare blending of earth sciences knowledge and experience with skills in systems and components gives TI *a unique capability in space-age technology.*

The founding company (GSI) is now the geophysical exploration arm of TI's Geosciences division, and these capabilities are extended to governmental agencies by the Geosciences department. Designing and manufacturing advanced instruments and systems in wide use by these parties and others is the Industrial Products Group, with such products as *WORDEN** gravity meters, *EXPLORER** seismograph systems and *seisMAC®* seismic computers.

For more about geosciences at TI, write to Merchandising department for Bulletin DM-101.

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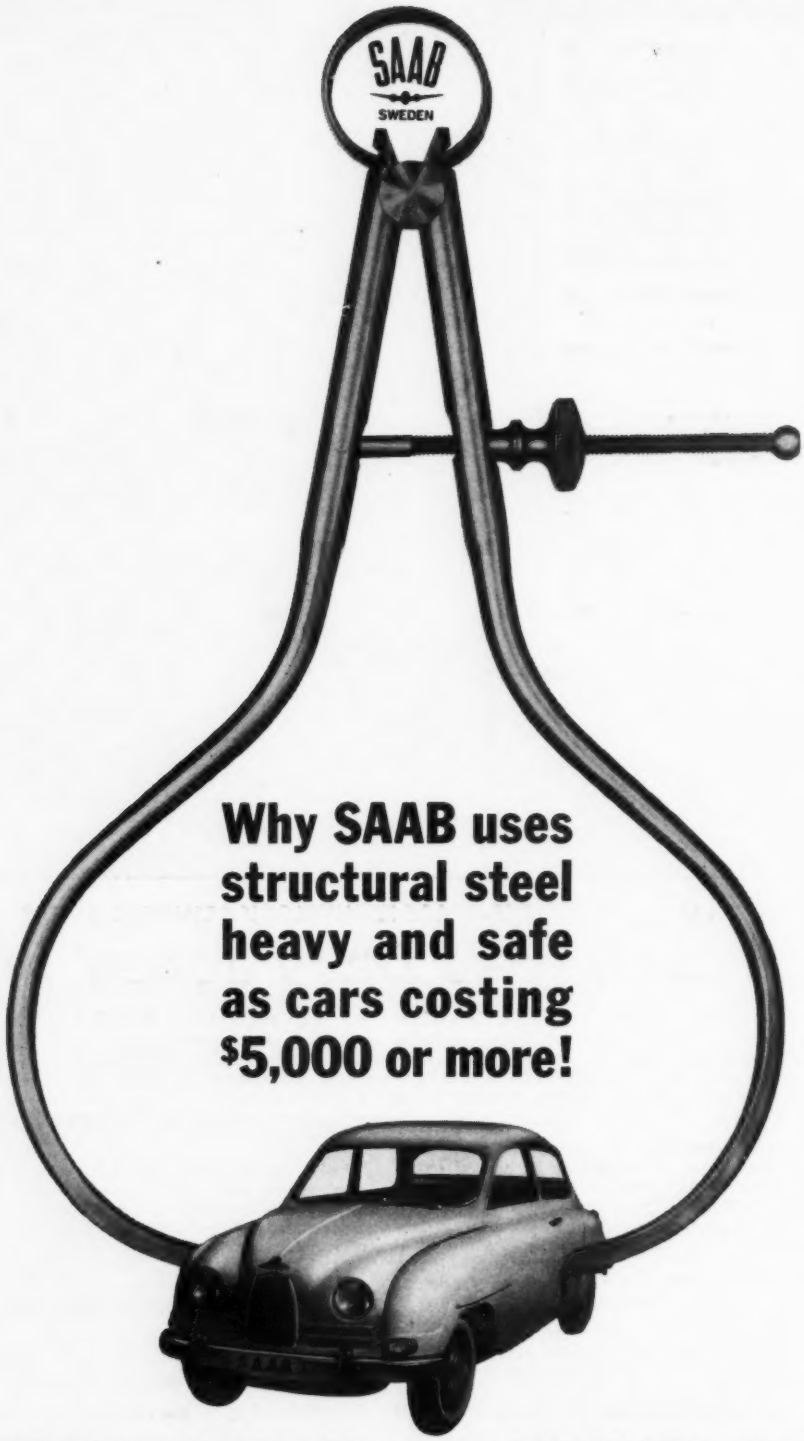

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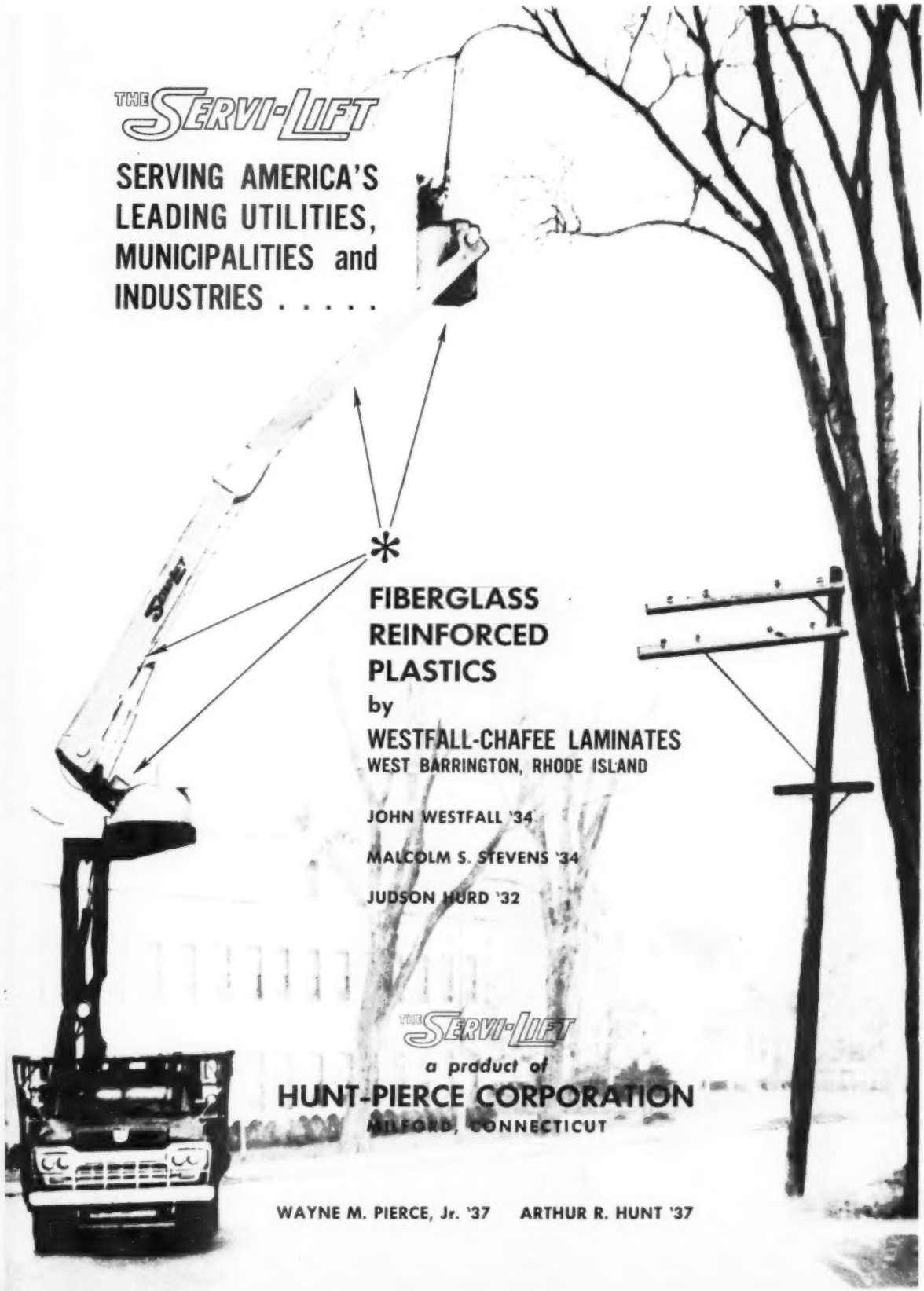
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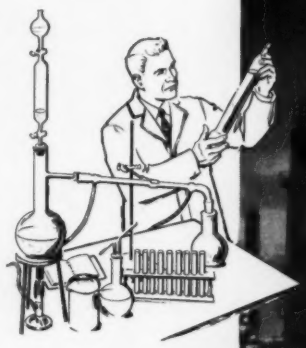

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The Corporation's unique position and significant mission have attracted a management group composed of some of the nation's foremost scientist/administrators. Heading this group is Dr. Ivan A. Getting, President, a former professor of Electrical Engineering and alumnus of Massachusetts Institute of Technology.

Among the highly skilled and highly motivated scientists and engineers who have joined Aerospace Corporation to date are these M.I.T. alumni:

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EDWIN A. GOLDBERG — *Associate Manager, Electromechanical Department, Systems Research and Planning Division, MS (1956) Electrical Engineering*

DONALD H. LEWIS — *Member Technical Staff, MS (1959) Aeronautical Engineering*

FRANK C. LOESCH — *Head of the Orbital Vehicle Department of a major military space program MS (1946) Aeronautical Engineering*

DUNCAN MACPHERSON — *Member Technical Staff, MS (1956) Mechanical Engineering*

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AVRON N. SPECTOR — *Member Technical Staff, MS (1956) Electrical Engineering*

EDWARD R. TOPORECK — *Special Staff Assistant to the General Manager, Engineering Division, MS (1931) Electrical Engineering*

CHIAO J. WANG — *Manager of the Propulsion Department, Systems Research and Planning Division, MS (1946) Mechanical Engineering*

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IVAN A. GETTING
President of Aerospace Corporation, a former professor of Electrical Engineering and alumnus of M.I.T.

Dr. Getting, as President of Aerospace Corporation, draws upon a distinguished career as research scientist and professor, as well as governmental and industrial administrator.

For the past nine years he has been Vice President, Engineering and Research, of the Raytheon Company. During the Korean war he served the United States Air Force as Assistant for Development Planning in the Air Staff, on leave of absence from M.I.T., where he was professor in the Electrical Engineering Department (1945-1950). He was director of the Division of Fire Control and Army Radar at the Radiation Laboratory, M.I.T. (1940-1945).

Dr. Getting holds his BS degree from Massachusetts Institute of Technology, where he was an Edison Scholar, and his PhD degree from Oxford University, where he was a Rhodes Scholar.

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A non-profit, public service organization dedicated to advancing and applying space science and technology for the United States Government.

Trend Of Affairs

The M.I.T. Telescope in Space

THE 39TH EARTH SATELLITE launched from the United States, Explorer XI, carried the second of two M.I.T. experiments in space into orbit on April 27. The first one had dealt with the solar wind. This one was a venture into gamma-ray astronomy.*

Associate Professors George W. Clark, '52, and William L. Kraushaar designed and built the telescope aboard the satellite. A Juno II carried this slim, tube-like, 94-pound satellite into orbit. Both professors were at Cape Canaveral for the launching. Both of two radio transmitters in the satellite began functioning promptly, and the Laboratory for Nuclear Science was assured of fresh data to analyze.

The telescope and the apparatus linked with it were designed to measure gamma radiation from all directions while the vehicle tumbled end-over-end during many trips around the earth. Gamma radiation is believed to be indicative of collisions between cosmic rays and particles of matter in the far reaches of space. Since it is not affected by magnetic fields or other influences, measurements of it may provide clues to the sources of cosmic rays. The instrument employed is extremely complex. It consists in this case of two detectors so shielded and connected to a computer that the desired information is extracted from a multitude of events. This then is spurted to earth by the telemetering system.

The New York *Times* noted in an editorial April 30 that by "serving as a new 'window' through which to observe radiations" this telescope was opening "a new era in man's exploration of his universe." And The *Times* concluded: "From the purely scientific point of view, the opening of this window into the far reaches of space must be regarded as of by far greater importance than the spectacular placing of the first man in orbit for a short time."

Drs. Clark and Kraushaar worked with balloons before satellites became available. Dr. Clark has been in the Department of Physics since 1949, and Dr. Kraushaar has taught at M.I.T. since 1951 except for a year devoted to cosmic ray research in Osaka, Japan.

*See "Two M.I.T. Experiments in Space," Technology Review, May, 1960, p. 24; and "Solar Wind Is Found," May, 1961, p. 14.

Only Yesterday in Aviation

IN THIS YEAR'S Lester D. Gardner lecture at M.I.T., Lt. Gen. James H. Doolittle, '24, recalled the first blind take-off, flight, and landing in the history of aviation. It was on a foggy day in 1929 at Mitchel Field. There was a hood over Doolittle's cockpit; Ben Kelsey, '28, rode with him as safety pilot, and Harry Guggenheim was on hand to see that first 15-minute demonstration of the practicality of all-weather flying.

General Doolittle, who is now chairman of the board of Space Technology Laboratories and a Life Member of the M.I.T. Corporation, also told about crossing the continent, in 1922, in less than 24 hours for the first time. He described, too, what it was like to be lost on a flight from Buffalo to New York and crash land in New Jersey because of lack of blind-flying instruments and radio communication.

One of the most interesting periods of his life, he said, was when he worked with Professor William G. Brown, '16, and many others now well known—Julius A. Stratton, '23, helped with fog-penetration studies—at the Full Flight Laboratory which the Daniel Guggenheim Fund for the Promotion of Aviation supported in 1928 and 1929. It was there that the Sperry Artificial Horizon and the Sperry Directional Gyroscope, descendants of which are now on every airliner's instrument panel, were developed.

General Doolittle's blind flight in 1929 showed what was needed. Instrument landing experimentation and development continued, and Captain Albert F. Hegenberger, '17, made the first solo blind flight in 1932. Two years later a blind-landing procedure became standard military practice. By then, General Doolittle concluded: "Flying by instruments had outgrown the early experimental phase. It was a practical reality, and aviation had entered a new era."

This was the third annual lecture on aviation's history made possible by a bequest to M.I.T. from the late Major Lester D. Gardner, '98.

Faculty and student parties in the Rockwell Cage followed the formal observance of M.I.T.'s Centennial. The photo above was taken during a concert after the students' excursion to Sturbridge Village in a special train on April 22.

The Mightiest Cosmic Ray Yet

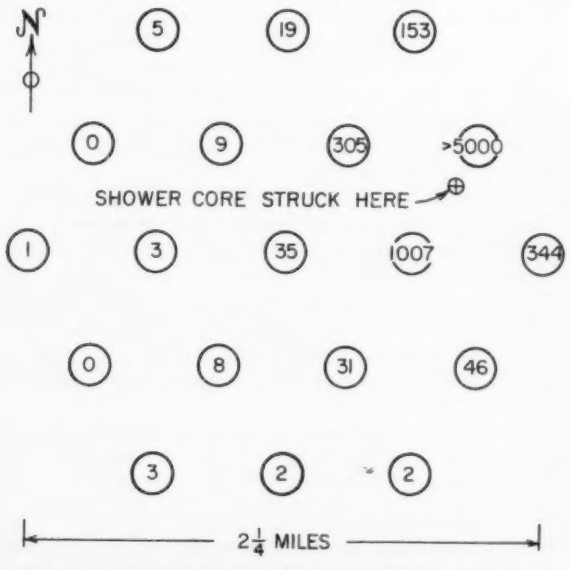
ON MARCH 19, the Volcano Ranch cosmic ray research station recorded an even greater shower of particles than ever was reported before. Last fall this same station reported the fall of 10 billion particles. This spring's shower was between two and four times as great as that "10-to-the-10th" event.

These showers of electrons and other small particles are "reconstructed" to estimate the energy of the cosmic rays that cause them. This spring's huge shower apparently resulted from the arrival near the station's edge of a particle with far more energy than ever has been imparted to anything with a man-made accelerator, and more than it seems likely that a particle could have acquired within our galaxy. Its energy exceeded 10^{19} electron volts and perhaps approached 10^{20}. The resulting shower appears, therefore, to have been produced by a nuclear visitor from beyond the region—100,000 light-years wide and 5,000 light-years deep—that the Milky Way occupies in space.

M.I.T. established the Volcano Ranch station near Albuquerque, N.M., three years ago. It has the world's largest array of detectors of such events. Each detector is a plastic disk resembling a millstone, in which there is a scintillation when a particle strikes it. Four such disks, covered with rice straw, are housed in each of a series of sheds spread over an area two and a quarter miles wide.

John Linsley, a bearded, western-looking young member of Professor Bruno Rossi's staff in the Laboratory for Nuclear Science, presides over this ranch and reported the record-smashing shower. Associated with him is Peter J. Eccles, another member of the Laboratory's staff, whose father is President of the Australian Academy of Science. Their work is supported by the National Science Foundation.

Will still bigger showers be recorded? Professor Rossi, who has been directing research which has resulted in the discovery of bigger and bigger showers, year after year, doubts if the limit has been reached. He has been convinced for some time of the extragalactic acceleration mechanism for cosmic rays, and this shower appears to be further evidence of it. But whether the incident particles that start such showers are protons or ionized nuclei of heavier elements is still uncertain, and much more work appears to be necessary to determine the nature of the cosmic particles.



The detectors are arrayed like this, and the group nearest the core of the shower was flooded with particles.

The Alumni Day Program

ON ALUMNI DAY at M.I.T., June 12, President Julius A. Stratton, '23, will report on the Institute's Centennial year and four members of the Faculty will participate in a symposium on "The University in World Affairs."

Dr. Stratton will speak at the luncheon in the Great Court following departmental reunions and motion pictures in the forenoon. The symposium will be in the Kresge Auditorium in the afternoon. The speakers then will be Walter G. Whitman, '17, Professor of Chemical Engineering on leave as Scientific Adviser to the Secretary of State; Jerome B. Wiesner, Professor of Electrical Engineering on leave as Scientific Adviser to the President; Max F. Millikan, Professor of Economics, and Carroll L. Wilson, '32, Visiting Professor of Industrial Management.

There will be a social hour in Briggs Field preceding the annual Alumni Dinner in the Rockwell Cage, and Arthur Fiedler will conduct the Boston Pops Orchestra in a concert that evening.

Housing for Married Students

A $3,000,000 LOAN from the federal government's Community Facilities Administration will enable M.I.T. to proceed within the next year to construct housing for married students.

One quite high and four three-story apartment buildings are planned, to be located at the corner of Audrey and Vassar Streets on the West Campus, where the Westgate barracks formerly stood. They will be divided into efficiency, one-bedroom, and two-bedroom apartments. Hugh Stubbins and Associates are the architects.

John Linsley of the Laboratory for Nuclear Science rides herd on the instruments spread across the western plain.

Macromolecules and Memories

ONE of five fellows of the American Association for the Advancement of Science chosen to picture scientific frontiers for the American Society of Newspaper Editors at their April meeting in Washington was Institute Professor Francis O. Schmitt of M.I.T. He both reviewed some of the macromolecular biologists' achievements and explained some of their hopes.

Even memory and learning, he suggested, may come to be understood better by further study of the large biological molecules. None of the macromolecules now known appears to meet all the requirements for the phenomena within the brain. But it is possible, Dr. Schmitt believes, that macromolecules meeting the criteria will be found if the search is pressed.

It is estimated that 10 billion neurons are involved in the enormously complex circuits within the brain, and for each neuron there are about 10 cells of another type called "neuroglia" whose functions are poorly understood. Memory traces are widely distributed through the brain and persist even though all electrical activity is interrupted. The number of bits of information that may be stored greatly exceeds the number of neurons available, and if some type of switching mechanism helps to retain all of this information, the switches themselves must be endowed with memory properties. Hence, it seems likely to Professor Schmitt that memory traces are really subcellular and probably macromolecular in nature.

The memory engram, he said, may be similar to the nucleic acid RNA which is produced at a high rate in neurons. According to one theory, the RNA's detailed structure, however, must respond plastically to the electrical activity of the sensory nerves, and it must be capable of precise replication to make the widespread distribution and long retention of information possible.

To make the fast recall of temporally related sequences of information possible, the help of other molecular types may be needed, and there may be a mechanism in which certain molecules function as semiconductors. Quantum chemists and physicists as well as biologists are challenged by this problem.

"Man's deepest need is to understand himself, the nature of his being and endowments," Dr. Schmitt told the editors. "A frontal, full-scale attack on the biophysical and biochemical nature of the processes by which the functions of mind emerge from the interactions of the microcosmic macromolecular equipment in the infinitely complex neuronal and glial cellular systems of the brain would seem to be not only salutary but very timely in view of the complexities and dangers of current world events."

The Library Problem

GILBERT W. KING, '33, Director of Research for the International Business Machines Corporation, has been chosen to head a survey of the possibilities of automating the organization, storage, and retrieval of information for the Library of Congress.

Librarian L. Quincy Mumford, in announcing the $100,000 survey, said it will deal with whether there can be effective mechanization of such huge libraries in the foreseeable future and whether an automated system would be as good as present manual systems.

COLUMNS OF M.I.T. NEWS poured out of this press room in the basement of Kresge Auditorium regarding the Centennial celebration in April. It served as headquarters for both foreign and domestic, science and political reporters.

Executive Development Symposium

PARTICIPANTS in an M.I.T. Centennial Symposium on Executive Development this spring included Harold F. Smiddy, '20, Vice-president of the General Electric Company, and Harold J. Leavitt, '49, Professor of Industrial Administration and Psychology at the Carnegie Institute of Technology.

The School of Industrial Management sponsored this three-day meeting at Endicott House of about 45 authorities on executive development, and Dean Howard W. Johnson and members of his Faculty led panel discussions of the papers presented.

Professor Leavitt's subject was "Unhuman Organizations" and he suggested that "the fact that machines can now think" will require a reconsideration of "our central concern with human fulfillment and creativity." Computer-controlled programs, he said, may require that industrial organizations become increasingly rigid in some areas, at the same time that they are very much loosened up in others.

Mr. Smiddy commented that although information technology may have the potential to force an entire organization, from the middle manager on down, into "a life of menial, stultifying routine and unrewarding work," it is questionable whether it should. "At least one sound, well-conceived concept—namely decentralization—provides an economically and socially competitive alternative," he said. "When a rapidly increasing part of the population has the education of today's college graduate, most people just will not accept as an unalterable condition that most of their life be spent in pursuits devoid of satisfaction."

(The Trend of Affairs is continued on page 58)

CENTENNIAL CONVOCATION speakers (shown by a portrait of Karl Taylor Compton) were, left to right: Joseph Harrington, 3d, '61, John A. Volpe, James R. Killian, Jr., '26, Clarence L. A. Wynd, '27, Mrs. Compton, Julius A. Stratton, '23, John C. Slater, John F. Baker, Joseph J. Snyder, '44 (Marshal), and Harlan H. Hatcher.

The Invocation by Mrs. Compton at M.I.T.'s Centennial Convocation

SOME *of the most memorable words spoken at the M.I.T. Centennial Convocation on April 9, in the opinion of many who were there, were those of Mrs. Karl Taylor Compton, who gave the invocation. Mrs. Compton said:*

At this moment of climax in our celebration, we pause appropriately for an invocation—an outreaching of our minds and an upsurging of our hearts beyond the immediate occasion and these visible evidences of our rejoicing, to the infinite God of the universe, source of all wisdom, of all life, of all being.

We have come together here from many cultures, many faiths, yet surely in this presence we can unite in common acknowledgment that it is indeed "very meet, right and our bounden duty that we should at all times and in all places"—but especially at this time and in this place—"give thanks to almighty God," by whatever name we may call him or in whatever form we may address our individual prayers.

We bow in reverence before the beauty and majesty of that universe whose myriad intricacies and vastness are being made known to us, bit by bit, by the work of so many minds. We acknowledge humbly our incalculable debt to all those who through the ages have extended knowledge or have deepened our understanding of ageless values.

But especially this afternoon we give thanks for all those individuals who have poured their lives into the building of this great university. Many of their names are forgotten. Others rush quickly to all our minds. Yet each has added a little to the sum and from the assembled whole there *has* arisen a certain grandeur. With devotion they have pursued into realms far beyond his imagining the injunction of Pythagoras, given so many centuries ago but pertinent for centuries still to come: "Go! Seek to know of what and how the world is made, and LEARN THEREFROM A BETTER WAY OF LIFE." Keeping faith with them we rededicate here all the resources of this great institution and ourselves, however small or great may be our part, to that imperative search at once compelling, rewarding, often baffling, but ever continuing and advancing.

And may God the father of all mankind, everywhere, in every nation and of every faith, unite us in that search and guide us on our way.

After this invocation, the greetings (reported on page 36) were given and President Stratton acknowledged them (in the speech reported on the next page).

The Centennial Convocation Address by the President of M.I.T.

The Fabric of a Single Culture

Science, in sum, gives us knowledge and power of action. It tells us what we can do; we must turn elsewhere to learn what we ought to do

BY JULIUS A. STRATTON, '23
The Institute's Eleventh President

WE HAVE come to the closing hours of our first century and the culminating moment of this celebration. The Massachusetts Institute of Technology is young as measured by the age of many institutions whose delegates have generously assembled on this campus from all over the world to greet us. We are moved by your tributes and by the spirit they convey. I am deeply honored that as President it is my privilege to respond on behalf of the Corporation and the Faculty, the students and the alumni, and of the friends of M.I.T. who are gathered here today. I do so most warmly.

This, of all times, is an occasion to look ahead, and it is about matters that lie directly before us that I shall speak to you this afternoon. Yet for one brief moment, let us cast back our thoughts over the hundred years.

Outwardly and materially, the world of 1861 appears at a backward glance but a crude prototype of our own. Nothing is more obvious than the changes that have been wrought by the stupendous discoveries and countless inventions of the intervening century. Yet, the same great currents of thought that we commonly identify with our own time had already begun to stir. The same conflicts of ideas were clearly visible.

Among educated people everywhere, and in the city of Boston in particular, there was an intense interest in science and invention. The idea of progress had, if anything, a greater hold upon the nineteenth century than upon our own. There was a confidence that science was the ultimate key to the welfare of mankind and a profound belief that in only a matter of time, science would reveal to us all the mysteries of our universe, would satisfy the material wants of peoples everywhere, and would bring peace and harmony among men.

Out of these convictions, there emerged a vision of the future that stirred the imagination and moved men to attach a new importance to useful knowledge. But there were then as now many who refused to accept this pragmatic view of life. Cardinal Newman in Great Britain, in a celebrated essay, defined the classic idea of a university, maintaining that its true purpose was instruction rather than research—to train the mind rather than to diffuse useful knowledge. Matthew Arnold eloquently defended the humane letters as the single path to culture. Against this ancient fortress of classical learning, Herbert Spencer and Thomas Huxley pressed their case for science and for relevancy in education to the problems of the day. A full century ago, the lines of battle between the "two cultures" were already clearly drawn, and the echoes of these great controversies were heard here in Boston.

Jacob Bigelow, a President of the American Academy of Arts and Sciences and a Rumford Professor at Harvard, concluded a memorable address in the 1860's with these words: "A few years ago, men witnessing the effect of an electric current on a magnetic needle wondered if a motive force could not be transmitted with electric speed to a far distance. A few years ago, men looking at their faces in a glass wondered if such an image could not be fixed on a plane surface, by the agency of light. A few years ago, men toiling slowly and wearily on highway roads wondered if the fatigue and loss of time could not be saved by some better mode of conveyance. A few years ago, men about to undergo surgical operations wished in vain that the attendant pain might in some way be averted. The solution of all these problems is now achieved by the triumphs of utilitarian science. The nineteenth century, one-third of which is yet to come, has already converted all these wants and wonders into physical and historical facts. Would the recovery of the lost books of Livy, the orations of Hortensius, or the poems of Sappho, be any compensation for the loss of any one of these from among our own cotemporaneous revelations?"

The response of the "other culture" to such declarations was immediate and forthright. The pages of *The Atlantic Monthly* in the 1850's and '60's and the minutes of the several literary clubs of this city record spirited and sometimes acrid discussions of the relative merits of classical and utilitarian studies. They record also the successful efforts of William Barton Rogers to found here a new kind of institution.

M.I.T. is the product of that generation and of a plan founded on faith in the dignity and worth of useful knowledge. Indeed, the history of this Institute over a

hundred years is interwoven with the economic and industrial development of the United States. Its progress stems from the need to apply the power and skill of engineering to the growth of a nation.

We of this generation of students, faculty, and alumni of M.I.T. can take rightful pride in the accomplishments of our first century. Yet as we look now to the future, we find ourselves caught up in a great forward surge of science that has no parallel in the past. Hardly a month passes without the announcement of a significant advance on one frontier or another. One would be foolhardy to predict the discoveries and inventions that lie ahead. But there is on every hand a pregnant sense of extraordinary things to come, a belief that man is on the threshold of many revelations, of profound new insights into the nature of life and the construction of the universe.

In our own century science has given to man an unprecedented power over his physical environment. But how shall he govern this headlong advance? How shall he be guided on his course? What shall he ask of science? What shall he do with its products? How shall *we* as educators teach the generations of scientists and engineers who are to follow?

From these most difficult and urgent questions, I draw three thoughts that I should like to express to you today.

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First, I want to speak of the advancement of science for its own sake. Science is the great quest for knowledge and understanding of the laws of Nature. Science is a structure that man is erecting piece by piece in the likeness of God's world. The great edifice is rapidly taking form. The beauty of the whole and of its parts is becoming ever more visible. The work commands the interest and consumes the energies of an increasing number of men and women.

Yet, while the quest for knowledge reveals the beauty and harmony of Nature, it can lead also into doubt and into places of darkness and fearful domains.

Just one hundred years ago, the theories of Darwin and Huxley relating to the origin and evolution of species were looked upon by many as an assault upon the foundations of religion. Today, biologist, geneticist, and chemist are pursuing a search that is taking them ever closer to the elements of life itself and may well disclose a complete evolutionary chain that leads from a primordial, inorganic mass into an organic, life-sustaining planet.

The physiologist and the psychologist are making rapid progress with their investigations of the structure and functions of the human mind and personality. As they proceed, there looms before us the terrifying possibility of the evil to which such knowledge may be turned—the power to control and subvert both mind and spirit.

To many people today, the idea of a thinking machine, of an electronic device that can simulate at enormous speed the logical processes of thought, is not merely awesome but abhorrent.

And I need hardly remind you of the appalling consequences that may flow from a misuse of our knowledge of nuclear fission and fusion.

One may multiply the examples at will. The prospects of potential evil or disaster are so many and so frightening that thoughtful people question how far we dare proceed. They ask whether science has not begun to trespass upon forbidden territory, whether there are not paths of investigation that henceforth must be barred to man's curiosity.

To this I reply that there is no retreat. We have no alternative but to follow truth wherever it may lead us. One cannot escape evil by ignorance. Whatever preconceived notions we may have of how the world is constructed must and will give way little by little to a more profound understanding of the laws of Nature as they actually are. Knowledge itself, as has been said many times, is neither intrinsically good nor evil; but the power that knowledge gives can be turned to evil purpose. Only our will for right against wrong stands between us and disaster. We must seek salvation not by withdrawal from the quest, but in man's own conscience, in his innate sense of decency and morality.

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I have been speaking of science as a path to understanding. I want now for a moment to talk of science as an instrument for human welfare.

The entire development of man, from his most primitive origins into a modern, civilized being, is the story of an unfolding interplay between tools and a directing mind and will. There is a common idea that, in the long, painful, tortuous evolution of human society, the enlarging brain and the progress of intelligence are always in advance of the inventions of technology. On this point the record is by no means clear. In fact, recent archaeological discoveries in Africa appear to link stone tools with prehuman primates more than half a million years ago. Such evidence suggests how behavior through the use of tools may have interacted with changes in anatomical structure, as well as in intellectual development, and how out of these interactions emerged man as we know him.

All our recorded history offers further evidence of this interaction between ideas and technology, between thinking and doing. The great cultural transformation that began to overspread Western Europe in the fourteenth century was the product of many factors; but any interpretation will be distorted and incomplete that fails to take account of advances in the use of wind and water power, or improvements in such simple devices as pumps for exhausting water from flooded mines. The theories of Galileo, Newton, and Huygens are among the grandest works of the human intellect. But the indispensable prelude to these theories was the invention of physical instruments—of telescopes, microscopes, and the air pump. In our own day, the profound new insights into the nature of matter and the constitution of the stellar universe, with all their philosophical implications, are direct consequents of great new machines, of particle accelerators, and radio telescopes; and these, in turn, have been made possible wholly by progress in engineering.

In sum, technology—or be it engineering—has contributed to man that small and sufficient advantage over the competitively hostile forces of nature that has enabled him thus far to survive and flourish. It has afford-

ed him a measure of security, a slowly improving economy, and—most precious of all—moments of leisure, without which there can be little thought or reflection.

Modern engineering draws increasingly upon the methods and ideas of modern science and in turn contributes increasingly to scientific progress. Engineering is a partner with science, and not a stepchild. Many of us have been aware and troubled by a curious mood too prevalent in some intellectual circles that arrogates an inferior grade to the part played in society by the engineer. I feel obligated on this occasion to reaffirm the importance of his role.

The institution that you honor today was founded upon the idea that there is both worth and dignity in useful knowledge. The motto "Mens et Manus"—the mind and the hand—is inscribed upon our seal. Nothing that one can foresee for the future diminishes the importance of a steadily advancing technology. I speak now not only in tribute to the engineer, but on behalf of all those men and women whose efforts are dedicated to the translation of knowledge and ideas into products and services contributing to the health, nourishment, social stability, and economic security of mankind. I include in their number the doctor, the teacher, the architect, the manager of industrial enterprise. All such professions have this in common—that they combine art with science. In a limited sense, art is defined as the knowledge gained by skill, experience, and practice; but it is also, and in larger part, an intuitive feeling for the special meaning of the materials worked with and for the particular order that will best express this meaning. One might, then, say that engineering is art governed by reason, or equally that it is reason organized by art. It is precisely this fusion of science with art that gives to engineering its special character and appeal. The engineer himself must take the highest view of his profession. The greatest opportunities and the most difficult problems lie directly before him—problems that challenge his originality, his intuition, his knowledge of the methods and data of science, his capacity to reduce ideas to practice, and, increasingly, his ability to manage the systems he has created.

The physical character of our cities and the quality of their design; the effectiveness of our future modes of transportation; the conservation of our natural resources; the synthesis and application of new materials; the creation of new industries; and the aid which we extend to other lands abroad—all these will be in large measure the work of engineers. These are vast responsibilities, calling for men of stature, and holding forth the possibility of great rewards in pride of achievement. They are worthy of the efforts of the most gifted young men and women of this oncoming generation.

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I have spoken of science as the unremitting search for understanding and of engineering as its working partner. But men must be moved by more than an aimless urge to investigate and to fabricate. We have in our hands even now an almost limitless capacity to alter at will the material conditions of our existence. One can hardly conceive a technological goal that will not yield to the engineer, if men will but put their minds and wills to the task.

Yet in this almost infinite array of possible projects, where shall we concentrate our efforts? It is all very well to assert that the applied sciences—medicine, engineering and the rest—are directed towards useful purposes and the welfare of mankind. But such declarations are meaningless apart from a larger framework of judgment. Who shall say in the longer view what is useful and what is not? By what criteria and by what plan shall we make these great and often fearful decisions?

The simplest of the considerations involved is merely that of economy of effort. The limitations upon the human resources of a country, even of one so wealthy as the United States, are such that we cannot undertake all things at one time. And to this dilemma of priority, the advance of science now adds moral and ethical questions of a totally new order.

One may, to take an elementary example, spray the fields and the forests with insecticide. The mosquitoes die, as was intended. But so also, perhaps, do the birds and the insects, until over a vast area the delicate balance between fauna and flora is disastrously unsettled.

The advance of medicine enables the doctor today to conserve and to prolong life but without assurance that this life will be meaningful.

By the use of chemicals and radiation the biologist can induce mutations in genes and chromosomes, and so by an appropriate handling of genetic materials create new strains of living organisms. The same genetic laws govern the evolution of human beings. Conceivably someone may have the arrogance ultimately to undertake the breeding of a strain of "good men." But who then shall determine the new model of the "good" man?

In a quite different domain, as yesterday's Panel on Arms Control warned, the consequences of a nuclear disaster might affect life on this planet for generations to come. It is just this inescapable fact that gives to the international problem of arms control a seriousness and an urgency without precedent in human history.

There is nothing in the new order of science that relieves any one of us of our personal, individual, moral, and ethical responsibilities. But science now presents to us not alone as individuals, but as societies and nations, moral challenges of a wholly new order of magnitude. The nature of these challenges must first be understood and then acted upon with all our energies.

Science, in sum, gives us knowledge and power of action. It tells us what we *can* do; we must turn elsewhere to learn what we *ought* to do. There is no certitude in man's affairs, and we learn by trial and error; but the errors are becoming increasingly expensive. For guidance we must turn to the accumulated record of all human experience, to the ethical teachings of our religious faiths, to the understanding revealed by systematic study of human behavior. These are the strands that through education must be interwoven with science and technology to form the fabric of a single culture, and the hope of a harmonious and peaceful world.

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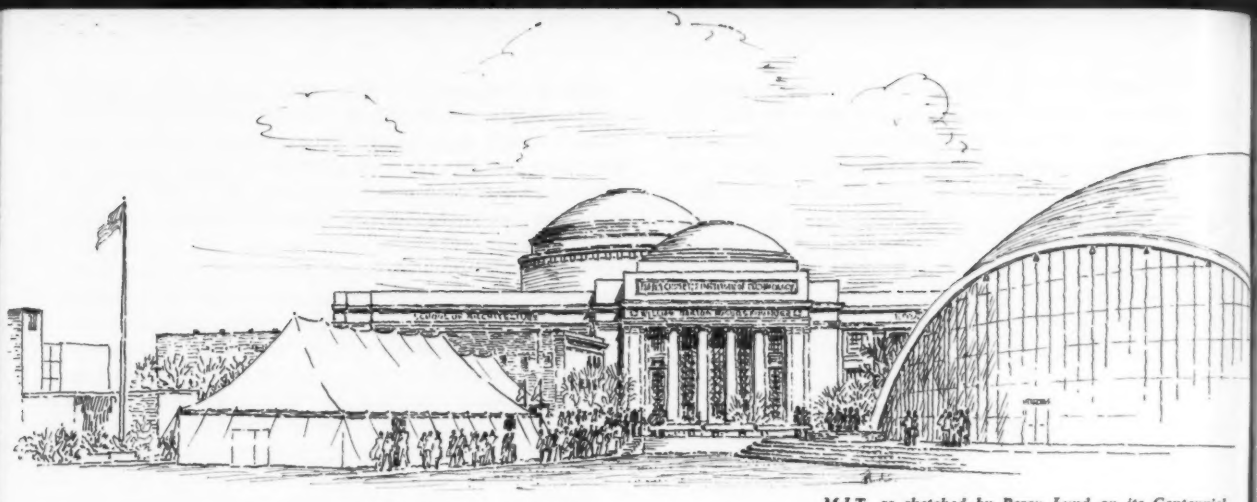
And so tomorrow M.I.T. sets forth upon its second century dedicated to truth through science, proud of its concern for useful knowledge, and alive to a new order of ethical and social responsibilities.



M.I.T. as sketched by Percy Lund on its Centennial

Some of the Centennial Greetings to M.I.T.

THE SPOKESMAN for Alumni at the Institute's Centennial Convocation on April 9 was their Association's President, Clarence L. A. Wynd, '27. Said Mr. Wynd:

In thinking about the relationship of its Alumni to the Massachusetts Institute of Technology, it occurred to me that I have seldom, if ever, heard the term "alma mater" used. Now while paternalism is a nasty word nowadays, I have never heard anyone speak in derogatory terms of mother. Of course, motherhood carries with it the aura of soft and loving care and feeding of the young.

The acquiring of an education at M.I.T. has been variously described by its students. The classic phrases, which they use, surely do not carry the connotations of kind and loving care.

Moreover, after mother has given her children this start in life, it becomes their turn to reciprocate as she enters the period of lavender and old lace and the rocking chair, but, at the age of 100, the Institute has certainly not taken on the patina of age. It seems rather to have discovered the fountain of youth which the early American explorers sought. These explorers, of course, were seeking eternal corporal youth which we know to be impossible of attainment, but eternal corporate youth can be achieved, and the Institute is ever renewing its aura of exciting and invigorating youth. So, I believe that the most appropriate greeting which I should bring from its Alumni to the Massachusetts Institute of Technology is not a filial one but rather a brotherly one. Nice going old chap—we are all with you. We shall forever be participating in *your* eternal youth by every support which we can give you—not alone because we feel a devotion and an obligation—but because this association does something to extend *our* youth also.

The students' spokesman was Joseph Harrington, 3d, '61. He quoted William Barton Rogers' "Plan for a Polytechnic School in Boston," and concluded:

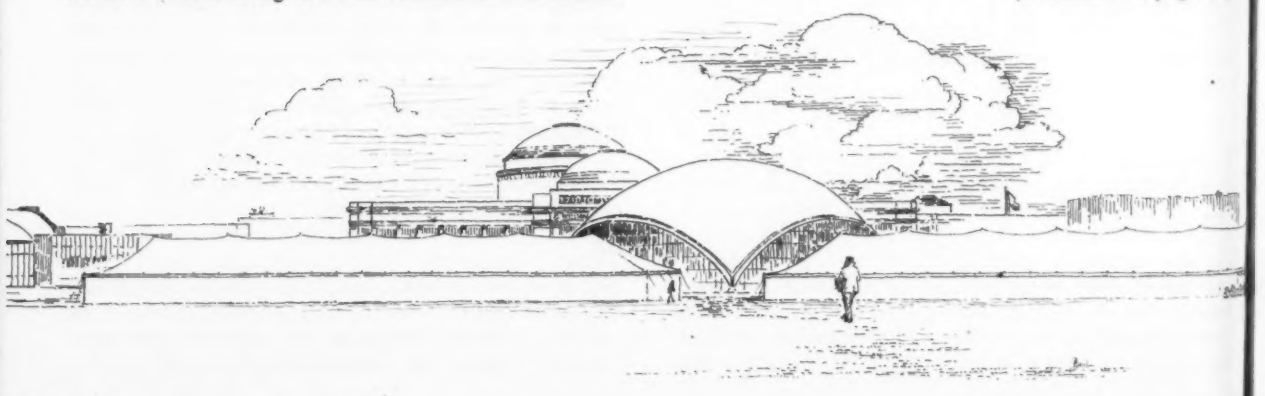
Although our school is not yet a university "comprehending the whole field of physical science and the arts," it is closer now to that goal than ever before.

It is to this ideal that we, the students of the Massachusetts Institute of Technology, tender our greeting and our salute today. We are saluting, not individual men, but an institution; already strong, destined to grow greater. We hope that in our time at the Institute, we can help it to move even closer to President Rogers' dream. If it does, we can be proud to join the procession of those who call themselves "M.I.T. men."

The Faculty, said its spokesman, Institute Professor John C. Slater, comes as near to being a pure and enlightened democracy as anything he knows, and he went on to point out:

An institution is a creation jointly of people and of ideas. This Institute is a straightforward product first of

(Continued on page 80)



The Centennial Address at M.I.T. by the British Prime Minister

The Free World's Problems

A call for wider unity of method, purpose, and organization to strengthen the Western Alliance

BY THE RT. HON. HAROLD MACMILLAN

KING WILLIAM IV once received a deputation with these words: "If my love for you equalled my ignorance of everything concerning you, it would be unbounded." I'm afraid your international reputation is too wide for me to be able to advance a similar claim.

Indeed, the Centenary of the Massachusetts Institute of Technology is an awe-inspiring event. You were founded to teach "the fundamental principles of positive science, with their leading applications to the industrial arts."

At that time no one could have foreseen the pre-eminent position which the Institute was destined to hold, not only in America but throughout the world. Both your method and your timing were right.

In these years the application of scientific techniques to the methods of production, distribution, transport, and the communication of ideas has set the whole human race on the march. This process will go on until it has revolutionized the whole conduct of human life upon this planet and perhaps beyond.

You follow the scientific method—by the ruthless logic of experiment. For you—as Thomas Huxley once said—the only tragedy is a hypothesis killed by a fact.

We politicians must seem to your trained and professional minds hopelessly amateur. Sometimes, we may have a success—more by good luck than by good management. Thus, occasionally, by pure chance, we may swing for the bleachers and collect a homer. Yet, for all your natural impatience with our shortcomings, you must feel a deep desire for your efforts to be matched by some comparable developments in social organization and political thought. This is the link between your work and that of those who hold high political office. I therefore make no apology for talking to you on a political theme. For if your achievements are not matched by the thoughts and deeds of political leaders, your work will be in vain—it will seep away into the sand.

If the world is to progress, the unity which science helps to promote must in due course be matched by harmony in international relations. Meanwhile we must face facts as they are. We must first achieve some real unity of political purpose and method in the Western Alliance.

Let us start with our two countries. Three years ago after a visit to Washington I spoke at Johns Hopkins University. I will only quote one phrase: "Whether we like it or not—and I do like it—the destinies of the English-speaking world are inextricably intertwined." At that time I was speaking in the presence of your President—my old friend and comrade, President Eisenhower—whose life for 20 years was devoted to the joint purposes of your country and mine. Before coming to Johns Hopkins I had spoken also at DePauw University in my mother's state of Indiana. There I declared my belief that if the progress of humanity was to continue this word "interdependence" must be the keynote of the second half of the Twentieth Century.

I want tonight to consider with you what this belief means and how we can translate it into effective action. No easy task, for it calls for something even more rare than intelligence—decision and resolution.

Now I have come to the United States to meet and take counsel with a new President at the beginning of his term of office. In his inaugural address the President said: "My fellow citizens of the world, ask not what America will do for you but what together we can do for the freedom of men." This notable phrase certainly matched the level of events. It has set the pattern for our talks together.

In the same spirit let us look, realistically and objectively, at the state of the Free World today. How have we been getting on since 1958? To be frank, we have been doing fairly well but not well enough. The vital center of the Free World's resistance, our Western Alliance, is no better organized, whether in the field of defense, economics, or political relations. If we have broadly held our own we have gained no ground.

When I speak of the Free World I mean the whole non-Communist world. There are, of course, many groupings of nations outside the Sino-Soviet bloc. Some of these are economic, some political, some cultural, and some defensive. But the core of the Free World is our Western Alliance, primarily the Atlantic Community. On its strength and vitality all depends. For if we can organize ourselves in imaginative partnership at the center, the effects of our unity will spread out through the world. Three years ago President Eisen-

hower and I declared for interdependence. Today I say interdependence is not enough. We need unity—a wider unity, transcending traditional barriers; unity of purpose, of method, and of organization.

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Our Alliance will only be united if it is secure against aggression. Otherwise it can have no life or strength. There are two roads to security. The best, the cheapest, the most sensible and the only one by which political man could match the successes of scientific man, is disarmament—comprehensive and effective: the only sure guarantee of peace.

I do not speak here of some mere paper treaty not commanding real confidence. I mean genuine disarmament, secured by effective controls—not a sham but a reality. Some day we may reach this goal which, up to now, like a mirage in the desert, always seems to recede the nearer we approach it. Certainly we shall persevere, for the prize is supreme. It is the banishment of fear. Even if we did not want disarmament on moral grounds, we certainly need it for economic reasons.

The cost of defense is a specially heavy burden for Britain and America—whether we think of it in terms of men, money, or resources. It weighs upon both our economies partly by our huge internal expenditures and partly by the direct cost in foreign exchange. All this puts a serious strain on our balance of payments. We in Britain spend overseas on defense about $620 millions a year. Of this $210 millions goes across the Exchanges in NATO. The rest we use in the cause of peace throughout the world. The United States are faced with the same problem at home and abroad. Meanwhile—until disarmament comes—the Free World must be secure and united.

Of course in this age of missiles, we must not overlook our conventional forces. Our task is to keep them mobile, hard-hitting, and up to date. Our military alliances all round the world are not aggressive or offensive. Their purpose is to see that little wars and adventures do not turn into great disasters. We must maintain these Alliances. They are permanent facts of modern life. But since unity is as important as security we must try to share the burden more efficiently. Surely it is illogical that our teams of military planners, scientists, and technicians should waste any of their efforts duplicating work and projects. Of course co-operation is not easy. Everyone is in favor in principle. In practice, they find it rather a nuisance. All the vested interests work the other way.

Nevertheless, this is a technical and not a political problem, which it should be in our power to solve. Standing behind these conventional forces is the great weight of the Western nuclear deterrent power. This guarantees our security. But here the implications of unity are more obscure and controversial. The first essential is that the deterrent should deter; this is self-evident and overriding.

Secondly, an effective deterrent should not be wasteful. Of course in recent years the relative advantage of the West has greatly diminished. We cannot afford to be too weak either in weapons or in means of delivery. All the same it is almost as important not to try to be too strong. The calculation is not an easy one to make. For as the armament of democracy will never be used aggressively, it may need to be larger than that of a potential aggressor. The very size of the area which we have to protect dictates some dispersal and perhaps some duplication. Yet we cannot afford waste.

Moreover, we must take care lest by building up our own security we perpetuate and encourage a nuclear arms race. That is one reason why I so earnestly hope for a successful outcome of the present negotiations in Geneva. The United States and Britain will do all we can to make this agreement with Russia to end nuclear tests.

But a test ban will not in itself give us nuclear disarmament. Meanwhile, the balance of priorities must be carefully weighed. The nuclear deterrent must take account of our necessarily defensive strategy. It must be effective, but not wasteful.

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If then our Western deterrent is both credible and efficient, what more do we need? I believe that there is a third element; although the nuclear deterrent gives us security, it is not yet so organized as to contribute fully to our unity.

All of us here know that America and Britain, who at present control the Western deterrent, regard themselves as trustees for the Free World. I think sometimes we are a little smug about this. It is rather like the trustees of a private fortune, of whom the beneficiary once said: "They may be my trustees, but I am not sure that they trust me."

Why was it that after the war Britain, under Labour as well as Conservative Governments, spent so many millions of pounds on a nuclear capacity? I will tell you. Although we in Britain have been accustomed for centuries to fighting our battles as part of an alliance, we have always been ready in the last resort to fight alone. There have been times when the world has not regretted our courage, even if they have judged it desperate.

Sometimes people doubted our determination. It was so in 1914 and again in 1939. Even today some people talk about "creeping neutralism" in Britain. Yet do not misunderstand our national character. Look at the record and draw the moral. So our determination to make our own nuclear contribution was in a sense instinctive. And perhaps, with the Atlantic Ocean between us, it has been no bad thing for the people of Europe to see that at least one European member of NATO shares the nuclear power with you. Besides, because of our geographical position and the advantages of increased dispersal, our British nuclear force contributes far more to the total Western deterrent than its size alone would imply. At any rate, all this is a matter of history.

Now let us turn to the position of our allies. When Sir Winston Churchill made his famous speech at Westminster College, Fulton, in 1946, he coined a memorable phrase: "The awful ruin of Europe with all its vanished glories glares into our eyes." How different is the scene today? Thanks largely to American help, poured out through the Marshall Plan and in other ways, the economy of Western Europe is buoyant—even booming. Above all, the spirit of her peoples is alive again.

"Technical developments overlap narrow national frontiers. . . . We all still think too cautiously, too parochially."

It is natural, then, that there should now be some in Europe who feel unhappy that their nuclear defense should be left purely in Anglo-American hands. There are some who think that you and we might unleash the deterrent rashly; there are others who fear just the opposite—that we might be too vacillating to use it at all until it was too late. Some fear our fingers on the trigger—others fear our thumb on the safety catch. So there is a certain unease in the NATO alliance.

What are we to do about it? We do not want, naturally, to alarm and perhaps endanger the world by appearing gratuitously to encourage the uncontrolled spread of nuclear weapons from country to country. We want a ban—if we can get it—on nuclear tests. We do not want our allies to feel it essential to their honor or their safety to pour out their money in wasteful duplication. Probably the West as a whole does not require an increase in total nuclear power. Nevertheless this is a real problem. We cannot just ignore it. We must find a way of meeting the legitimate feelings of our European allies.

Naturally, every extension of trusteeship, every increase in the concept of partnership, has its dangers. But the health of our whole NATO alliance depends on finding a way of building a partnership in the nuclear as well as in the conventional field. The prize of this would be great, and a double one: the prevention of an uncontrolled extension of nuclear manufacture and, secondly, the sense of real unity which would follow a new agreement with our own allies.

In attacking all these problems in the field of defense we have the advantage of the new and fertile mind of a young and forceful President. In the spirit of partnership we must review the burdens and the responsibilities. Some of these are uneven.

This could be tolerated in the early years after the war with a shattered Europe to protect. But now, in the 1960's, we must look again at our system, if it is to endure. In the same way, the question of nuclear power is fundamental. Its organization is an issue on which the unity of the Atlantic Community may stand or fall. These questions cannot be evaded. They must be faced.

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So far I have spoken of unity in the context of our military alliances. Is this enough? Surely not—and for this simple reason. Happily the present struggle in the world is not primarily in the military sphere. Nuclear weapons at least see to that. The real test will not be on the battlefield but in the market place, even the classroom.

It is now almost 15 years since the main structure of our present system for world trade and payments arrangements was designed. That was in the heyday of the East-West war alliance. The founders of GATT, the signatories of Bretton Woods, and all the architects of our postwar system could not foresee the full economic effects of the great divide.

World economic unity would have been hard enough to achieve in a world of Nineteenth Century nation states; it became impossible as the full effect of the Sino-Soviet system manifested itself. At the same time a new economic force has appeared in the world.

The second Industrial Revolution has already swept through our developed economies and is still only in its early stages. I am sorry to have to tell this audience that it is largely your fault, for this revolution is of a scientific and technological character.

These technical developments overlap narrow national frontiers. They require, for their effective exploitation, ever larger economic units.

I readily admit that in spite of these new factors our international trading and financial arrangements have somehow or other managed to carry a great increase in world production and trade. But no wonder they are now beginning to creak and groan, for they are really an old model. Sooner or later they will have to be traded in.

There are now three main problems to be resolved: The first is how to maximize world trade. This is essential to the prosperity of developed and undeveloped countries alike. Secondly, how best to organize assistance and capital to build up the less developed countries. Our common humanity cries out to us to help here, our economic interest in new markets encourages us, and political necessity compels us. And lastly, how to finance an ever increasing volume of trade and aid. If our monetary arrangements are bad, or outmoded, we shall not succeed. We shall stagnate instead of expanding. And Capitalism must expand or perish. Even Marx knew that.

First, how to organize world trade. Are the present international trading arrangements and institutions, evolved 15 years ago in quite different conditions, really appropriate to the circumstances of the sixties? We all still think too cautiously, too parochially.

We need to think not so much nationally or even in terms of greater economic co-operation between nations but in terms of wider groupings. For the advantages of size, of large areas transcending national boundaries where capital and labor and goods can move without impediment are surely more manifest to us year by year.

In Britain, we are already in the center of two important trading groups, the Commonwealth and the European Free Trade Association. The Commonwealth trading structure came into being during the great depression between the wars. It is based on a preferential system between the partners, with free entry into the United Kingdom.

But the new developments in Europe are of a different order. The six Common Market countries are successfully forming a full Customs Union which bids fair to be as great in population and strength as that of the United States itself. The Seven—now, with Finland, the Eight—have constituted the European Free Trade Association.

Elsewhere in the world similar groupings are in prospect. What then are we to do? There are, of course, the pessimists—who observe progress, but deplore it; who think it is better to travel despondently than to arrive. These people, no doubt, would try to reverse these trends, or they would ignore them and pretend that nothing has changed.

Surely what we have to do is to use these developments for the benefit of the whole free world. I have no doubt of what our aim should be. We ought to work

Standing behind Mr. Macmillan are President Julius A. Stratton, '23, Sir Harold Caccia, and Dean John E. Burchard, '23.

for the largest area of free trade that we can create.

Free trade for the Free World! That may still be but a vision. It may be a long time before it can take practical shape. Yet many new and vital ideas are now being discussed by practical men which a few years ago would have been dismissed as impractical dreams.

Some of these policies and plans would be quite revolutionary in their effects. Others are more in the nature of palliatives. There are naturally many different views and crosscurrents. But there is a new spirit abroad in the world—you can feel it everywhere. The young are intoxicated by it, and the old happily reinvigorated. It is the spirit of enterprise and adventure, moving into the second half of the Twentieth Century, and soon to knock on the doors of the Twenty-first.

For us in Europe the urgent problem is that of bringing together the Six and the Seven—now the Six and the Eight. I believe that we must and we can do this without detriment to our domestic interests or to our Commonwealth association and without injury to any other nation or group of nations.

A comprehensive arrangement in Western Europe, not highly protective, looking outwards and not inwards, building up its own strength but ready to help others—this would be a real benefit to the whole Free World, both economically and politically. Economically it would take us nearer to a still bigger area of free trade. It would prevent much duplication of investment.

It would stimulate trade and demand. Nor do I believe that a comprehensive European group would harm the United States. United States industry has in the past always obtained its full share of expanding trade.

The pattern varies across the great range of industry but the broad picture remains. A European settlement will bring great economic benefits—the political gains will be even more significant.

The consequences of the economic division of Western Europe are only just beginning to make themselves felt in the political field. Yet, if this economic division persists, the political rift will inevitably widen and deepen. This must, sooner or later, affect our military coherence and strength. It will be a canker gnawing at the very core of the Western alliance. If new and extended patterns of trade are vital for us and our future, they are equally important for the less industrialized countries. These countries have two material needs from us. They want more aid and they want more trade. Trade is really better than aid, with nations as with individuals. An intelligent and energetic man should be able to earn more money than he is able to beg or borrow from his friends and relations.

Expanding trade brings the healthiest economic growth. But trade cannot be confined to primary products, important as these are. Of course there are difficulties for the industrialized countries in accepting increased imports of manufactured goods from developing countries. Of course there is the possibility that sudden or unrestrained increases over a limited range of products can cause too great a disruption for our own producers. We must try to deal with these cases by friendly agreement with the country concerned.

You have done this with Japan, and we have done it with Hong Kong. But the broad rule should be to admit goods as freely as possible subject only to special modifications which are essential to prevent disruption for our own producers.

Nevertheless, primary products are still the lifeblood of many less industrialized and less developed countries. So expanding trade in the industrialized and developed countries is often the best way to help. For such expanding trade stimulates the demand for primary products. Between 1950 and 1951 commodity prices went up over 20 per cent. That was during the Korean boom. By 1960 they had fallen again below the 1950 level. It would certainly not help the primary producers to try to push prices artificially high.

But there are many schemes for particular commodities which have helped to iron out violent fluctuations in the short term and to give some stability to prices. We must study these problems—urgently.

In its various aspects, trade then is of paramount importance. But trade does need supplementing by aid. In this, up to now, the record of the West compares more than favorably with that of the Communists. In my speech to the General Assembly of the United Nations last September I gave the figures. They are startling and unanswerable. Yet I am not sure that the West always gets full credit for what we do. Much of it is provided through such bodies as the World Bank and now the International Development Association. Although these are within the framework of the United Nations, they are in fact boycotted by the Communist countries. I do not see why we should be content to hide our light under this bushel. That is why I welcome our new—and entirely Free World—machinery: The newly constituted OECD—now to be supplemented by a revised and strengthened DAG—strange initials, under whose frigid exterior is concealed a rare warmth of kindness and imagination.

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Trade and aid are very important. But the medium for both must be money—enough money. Of course economists are apt to make heavy weather about money. Naturally, for it's their mystery. But it is really quite simple. Just as each individual country painfully acquired a central banking system, so there ought, ideally, to be a central banking system for all the countries of the Free World. We are still a long way from that although, with the various international institutions which have come into being since the war and with the ever closer co-operation of Central Banks, we are groping our way forward. The present system is certainly not perfect.

As technical men you wouldn't tolerate it in your sphere. First there is the imbalance of payments. If you will forgive a rather frivolous comparison our system now is rather like a children's game when the family sit round to play rummy, or cooncan, or poker, and one child gets all the chips and another has not enough to go on, something must be done. Either more chips must come out of the bank (which Father keeps) or the winning children must hand over some of theirs to the others. Otherwise the game stops.

So in the modern world, if one country were to accumulate all the reserves and lock them up, our system could not go on. I do not suggest blame to any particular countries for the present imbalance of world

payments and reserves. This imbalance is in a sense only the external result of policies arising from the often contradictory fears of individual countries.

In the United Kingdom, for instance, we have a horror of mass unemployment. That dates back to the time between the wars. Now we have full employment —in many parts of the country more jobs than men. On the other hand we have to worry about the dangers of inflation and balance of payments difficulties.

In Germany they have different priorities; they worry more about inflation than anything else. That, too, is for historical reasons—because of their experience when, in Voltaire's vivid phrase, paper was reduced to its intrinsic value. These different national preoccupations have naturally created international difficulties.

Secondly, there is the volume of money. Imbalance of payments is only one aspect of the problem of money. Imbalance deals with who has the chips—or the money—at any given moment. But is there enough money? World trade has expanded four times in terms of money since before the last war. Yet the Free World credit base is only twice as big. No wonder some people argue that we have not got enough reserves in total and must create more to finance expanding trade.

All sorts of remedies have been suggested. The main difficulty about many of them is what I might call the mental hurdles which they present. It is normal to think of money as something painfully acquired; a dollar represents so many drops of sweat or so many ulcers. There seems to be something immoral in increasing credit by mutual agreement. It is done often enough in our internal economies; but the extension to the international field is hard to swallow. All the same, I repeat, expanding trade needs expanding money.

So there are three elements in the economic problem of the free world—trade, development, and finance. They are closely linked.

The needs of our time demand a new attitude to all of them. An old-fashioned or doctrinaire approach is not good enough. We must use the energy and abundance of our free enterprise system to transform our economic life. Above all, we must try to jump the mental hurdles. If the political leaders in the great countries of the world have but the will, the experts will doubtless find the way—or rather several ways—for us to choose from. But we must have the will.

First, we must be ready to welcome the progressive development of new trading arrangements and to see in them a means of moving towards a wider system of unfettered trade throughout the free world as a whole.

Secondly, the industrialized nations must accept their responsibility for raising living standards in the less developed countries, both by trade and aid.

Thirdly, we must ensure that the credit system in the free world is adjusted to these needs and that money becomes the servant and not the master of man's needs. This complex of economic questions is the second great problem whose issue may be decisive for our way of life.

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I remember one of our great judges remonstrating with a somewhat prolix barrister, pleading in his court, with these words: "There is in chemistry what is called saturation point—I have reached it." Nevertheless, at the risk of earning from you a similar rebuke, I must repeat—my theme is unity.

In certain spheres, at least, we must reach out beyond interdependence to united action. I have tried to show how we might do this in the military and the economic fields. Should we also attempt a greater political unity or even union in the Free World? Certainly we must try to agree on our policies and to unite in pursuing them. But if the West were to become as monolithic as the Soviet bloc we should lose that very independence of spirit in which we believe.

In any case our diverse national traditions are strong and fruitful. It would be folly to tamper with the loyalties for which men will strive and sacrifice. So when we call for unity in the Free World we should not think —at any rate at this moment of history—in terms of a politically federated or unitary State.

A World Government seems far away, and even a Free World Government is only a distant dream. Nevertheless the nature of the struggle for the hearts and minds of men is such that no one country, not even the greatest, can stand alone.

The first lesson for us to accept is that our political ideas must never be nationalistic in the narrow sense. It is no longer right to consider policies exclusively in relation to the United States or Britain; even Europe or the Americas or the Commonwealth are not big enough. That means a revolution in our thought.

We in Europe will no longer be able to indulge in dreams of self-sufficiency—let alone the wilder chimera of being a Third Force between the United States and the Soviet Bloc. You in America will have to resist the temptation to think of Europe as a cross between a bear-garden and an Old Curiosity Shop with certain undoubted tourist attractions. Nor must we forget that the Free World is far larger than any military alliances. There are many nations who would not wish to join us in these groupings but are nevertheless at one with us in the strong determination to preserve their independence and their own way of life.

A few weeks ago a meeting of the Prime Ministers of the Commonwealth was held in London. Twenty years ago this body consisted of only five countries, all of European stock. Now there are more than double that number, including members in Asia and Africa. The Commonwealth represents the triumphant evolution of our colonial policy, for we have given these countries the twin benefits of freedom and order. Nowadays the Commonwealth includes some of the most important non-Communist countries, not ranged with us militarily, but spiritually and ideally our partners.

This recent meeting, as you may have heard, had its melancholy side. But the decision of South Africa to leave us—I hope only temporarily—has at least underlined the essential characteristic of the Commonwealth today. It is an association of different races and peoples. It is dedicated to the ideal that all peoples, of whatever race, color or creed, should have full equality of opportunity in their own countries and in the world.

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To sum up: you and we believe that individual peoples and individual nations should be free to pursue their

The Rockwell Cage was filled to capacity and many thousands more heard the British Prime Minister's address via television.

own ideals, and that this is compatible with widely different cultures and traditions.

The Communists, on the other hand, have an ideology which insists that it alone is right. Inspired by this rigid creed, Communism seeks to impose its own system on the world. Our unity, therefore, cannot be enforced. It must develop freely—not as a result of external conquests, as with some great empires in the past, but through an organic and conscious growth.

If then we reach out towards unity in our defense, in our trading policies, in our economic life and in our political thought, shall we in the West have won the world struggle? At least, I would say, we shall have put ourselves in a position not to lose.

This whole generation are taking part in a great and dramatic debate—conducted, not just in words or thoughts, but with all the formidable apparatus of power. Its result will be judged by the harsh tests of practical success. Nevertheless, the struggle between what we call the Communist bloc and the Free World is fundamentally an attempt to decide between two concepts of humanity—the idealist and the materialist.

Will man's destiny be fulfilled when once all men can satisfy their material needs? Or is there some deeper purpose, some higher power of which our bodies are only the transient manifestation? This great debate—I say—goes on across the world. It is not daunted by frontiers nor shut out by censorship. Sooner or later men and women in the Communist world will seek once more the answer to the eternal questions:

Why are we here?

What is life's purpose?

Is there a right and a wrong?

Is there God?

Our Faith tells us that they will ask these questions and that in due course they will find themselves forced to answer them in the idealist sense. Then the great struggle on which we are now engaged may suddenly seem irrelevant. It may become a mere disagreement as to the best forms of social organization. It is against that day that we must prepare and until that day that we must hold on and hold together. This does not mean that we should abandon our efforts to use the United Nations Organization to the full. For it does at least stand for the principle of international law as the basis for international life.

Nevertheless, it would be foolish to disregard the pressures now being exercised and the attempts of the Communists to turn the United Nations, not into a forum for negotiation, but into an arena for propaganda. Therefore, while we must struggle on to make the United Nations a success, we in the Free World must strengthen rather than weaken our own unity. These measures which I have suggested, and others which will become necessary, are the essential framework to buttress our endurance. If these things are not done, then our Western free idealist way will fall apart, and our disunity and weakness will discourage those very elements in the Communist world which otherwise in time will work its salvation and our release.

There is always change and movement in our lives. History does not stand still. Unless we work for greater unity now we shall slide into division. The time is short. Let there be no delay.

The Institute's honored guests banqueted at the Statler (above) while 1400 Alumni dined on campus on Centennial weekend.

A Magnificent Challenge to Scientists and Engineers

AT THE Centennial Banquet on April 8, Chairman James R. Killian, Jr., '26, of the M.I.T. Corporation delivered the principal address. Dr. Killian said in part:

I HAVE spent enough time and energy this past decade working on problems of national security and strength to have gained an indelible sense of the hazards we face, the enormous difficulty of reducing these dangers, and the urgent imperatives to maintain Free World strength and unity. Despite all this I still have an abiding conviction that we can, that we must, clear the roadblocks to peace, that we can bring the arms race under safeguarded control, that we can reduce suspicion and misunderstanding between East and West, between little nations and big nations, between creeds and races. We will not progress towards these goals without a faith that even though the dawn may be cloudy, we stand on the threshold of a better day, a day of such splendid possibilities for all peoples that they surpass the imagination.

One cannot live in the atmosphere of a great research and educational institution, renewed year after year by youth with its hopes and energies and by students, old and young, with their dreams and discoveries, without acquiring a faith in the power of intelligence, operating with good will in an environment of freedom, to achieve this kind of future.

Clearly at this point in history scientists and engineers are in a uniquely favorable position to help in reducing tensions, in encouraging co-operation between nations, and in meeting the crisis of the newly developing nations. I do not suggest that science is the sovereign remedy for the world's turmoil, strife, and cleavages. It is not. Political leadership marked by wisdom, imagination, and maturity is an overriding requirement and all the professional resources and wit of nations are required to keep the peace and to maintain the Free World strong, free, and unified. . . .

Since our principles and policies impel us to aid the new and less developed nations, we must face the fact that our knowledge of how to do it is frequently as underdeveloped as the nations we would help. Our aid programs should be supported and guided by a research program as intensively and professionally pursued as the research and development programs underlying our defense. An idealistic impulse to aid is not enough; we must bring together teams of specialists—economists, engineers, agriculturists, sociologists, educators—carefully prepared and armed with research results for work in the specific area to be aided.

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Short Reports on M.I.T. Centennial Panels

Man's New View of Himself

BY WILLIAM PINKERTON

WITH a witch on trial, science did not divert the flow of justice in the courtroom of Sir Matthew Hale. This Lord Chief Justice of England was a Seventeenth Century man of wide learning, well versed in law, literature and philosophy. What is more, he took great interest in the mathematics and physical sciences of his day. Yet, when the old woman came before him charged with cursing a neighbor, Sir Matthew heard the evidence solemnly: shortly after the curse, the neighbor testified, "as soon as his sows pigged, the pigs would leap and caper, and immediately fall down dead;" a few weeks later, the neighbor was "vexed with a number of lice of extraordinary bigness," and had to burn his two best suits to get rid of them. As an act of justice, morality and piety, the witch was hanged.

That story from three centuries ago, told by the British novelist and philosopher, Aldous Huxley, opened for an audience which filled the great sweep of Rockwell Cage on April 8 this question: How Has Science in the Last Century Changed Man's View of Himself?

To think out loud about the answer under the urbane prodding of Dean George Harrison, four fine brains looked out from the conference table: two philosophers, Huxley, and the Protestant theologian Paul Tillich; and two scientists, psychologist Jerome Bruner of Harvard and physicist J. Robert Oppenheimer of the Institute for Advanced Study at Princeton.

Seventy years after Sir Matthew's verdict against the witch, Huxley noted, the world-view which made the judge so sure had evaporated. Man was beginning to see more in the cosmos than a "haunted telephone booth (built in B.C. 4004)." Galileo had challenged the earth-centered view of the universe, Newton had studied gravitation, and Harvey had demonstrated the circulation of the blood. By the time M.I.T. was founded in 1861, other concepts were altering the world-view, particularly Lyell's geology and Darwin's *Origin of Species*. From the mid-Nineteenth Century, the stream of ideas grew as the Institute grew: men studied germs, the unconscious, radioactivity, relativity, uncertainty, quantum theory, nuclear physics, and the theorems of Goedel.

What world-view can man accept now? Huxley answered: "For man as a private individual, a change of world-view is not quite so important as the professional manipulators of symbols would have us believe . . . It is not primarily by words and notions that adults and children can be made happy or even virtuous; it is by decent living conditions, by love received and given, by a sense of worth admitted by other people, by a sense of belongingness that we are made happy.

"But . . . in the complex world of advancing technology, rocketing populations and idolatrous nationalism, personal happiness and personal virtue are not enough. The unique individual is also the citizen,

J. R. Oppenheimer

Aldous Huxley

Jerome S. Bruner

Paul J. Tillich

EACH of the five reporters who covered Centennial panels for The Review found the discussions stimulating: William Pinkerton is director of the Harvard News Office; Robert R. Rathbone is associate professor of English at M.I.T.; Laurence W. Martin is assistant professor of political science; John Pomfret is an editorial writer for The Milwaukee Journal, *and Robert Toth is a science reporter for the New York* Herald Tribune. *Mr. Pomfret and Mr. Toth have been at Harvard as Nieman Fellows this academic year.*

a member of the dominant and most destructive species on this planet. . . . But in the future, as in the past and at the present, the collective destiny of the race will be in the hands of a minority. If the members of that controlling minority—such as you here at M.I.T.—can understand what is happening and what is likely to happen in the foreseeable future . . . if they can accept, resolutely yet humbly, without arrogance, the terrifying responsibility for human and even planetary destiny imposed upon them by the new view of man and the scientific achievements to which that new view is a corollary—then we can look forward to the future with a measure of confidence."

If this minority fails, however, to accept the new view of man and nations, we are in for "the worst quarter-hour in human history."

Tillich, in turn, stated the problem in terms of man's inner aim, his "telos." For the Greeks, it was to make actual man's potentialities; for the Middle Ages, the aim was to elevate man from a universe of finite aims to a universe of ultimate reality; since the Renaissance, man's aim has been the active subjection and transformation of nature and of man's own world.

But what is the end, if the production of means is the inner aim? It is true that the production of tools serves man's happiness, glorifies man's possibilities, liberates him, makes life easier and longer for the mass of people. But the loss of a true inner aim—the endless production of means without an end—dominates our era.

Three shocks changed man's view of himself in M.I.T.'s first century. First, there was the shock of evolution. This shock vanished when it was understood that the genesis of a being does not determine its character. The view of man as creature was not changed but deepened by the theory of evolution. Second, there was the shock of the concept of the unconscious. The shock came originally from the ethical implications, from Freud's antireligious bias, and the resistance of moralistic society to discovery of its underground motives. But the concept has become a powerful support for the religious valuation of man's predicament. The third shock was "reductionist behaviorism"—the idea of the conditioned reflex, and "social and psychological engineering." This was the shock of Huxley's *Brave New World* and of psychologist B. F. Skinner's novel *Walden II*—the notion that man is nothing more than an object, a thing altogether conditioned; and the universe is the sum of things to be described and manipulated. But who controls the psychological conditioner and who manipulates the social engineer? The only answer given is the Big Brother of Orwell's *1984*.

Science cannot reduce the bearer of science to a mere object of manipulation. Against the falseness, not of science and technology, but of "scientism and technicism," Tillich called for a view that includes "all dimensions of the multi-dimensional universe man is."

Turning then to the scientists, Dean Harrison called for the answer of Professor Bruner, who has been studying the effectiveness and ineffectiveness of processes in human problem solving, and whose recent book, *The Process of Education*, has been widely discussed. He offered these propositions:

¶ Man does not treat directly with nature. Nature, instead, is a construct, "a symbolic world of man's own collective creation," designed to put order into experience.

¶ Man's image of himself is limited and given shape by his view of the world.

¶ Fate is basic in man's view of the world. And Fate is that which is beyond one's control. In our day, the peopled Fate of the classic Greeks has given way to the Fate of mathematical statistics and statistical mechanics—to pure unknowable randomness.

¶ The inverse of Fate is what is humanly possible. Each discovery of man is an incursion into Fate, and rolls back the limit of Fate.

¶ The increase in what is humanly possible brings an elaboration of technology and a division of labor. More things are possible now, but social and technological organization are necessary to bring them off. The artificer of the possible is now society rather than the individual.

¶ Man's image of self is anchored in his intimate way of life. We have not reduced the tragic in life, but we have widely expanded the conception of what is technologically and humanly possible. The deepest change is man's view of the self as intelligence, of man as knower, and of science as an enterprise of thinking. In our technology, we have advanced to the use of artificial intelligence resting on computer techniques. Today, technology is seen, not as an extension of man's arm, but as an extension of his intelligence.

With the collapse of a transcendental doctrine, man sought the ersatz absolutism of the Right or tried to sanctify Marxist inevitability. Both are opposed to the definition of ideals in terms of individual reason and compassion. There is another possibility in a human ethic based on the psychological study of man. We are moving to a new ideal: the cultivation of individual excellence. Typical is the reform movement in American education today, sparked by the work of Professor Zacharias in the Physical Science Study program at M.I.T. Here, man is rolling back Fate by increasing his own effectiveness.

Finding how we may use our capacities as human beings effectively is more exciting than exploring empty space. In developing the arts of peace, we may find an expression of the new image of man that the century has produced. It has been powerfully energizing for the full utilization of our powers as human beings. We must aim to live at the full limit of what is possible—to use effectively those portions of Fate that we have taken over.

Finally, J. Robert Oppenheimer rose, to warm applause, to tackle the question: How Has Science in the Last Century Changed Man's View of Himself?

To be shocked by a scientific advance, he suggested, one first must have held the world-view that is to be replaced. For this reason, science has affected man's view of himself less in the last 100 years than in earlier times. The new ideas of physics—the expanded universe, the special theory of relativity with its "unhitching of man's ideas of space and time," and quantum theory which "shot out any complete determinism from the heart of physics"—were not terribly relevant to the anxieties, the hopes and visions of life among men. It takes an accident to make a scientific

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Their Ultimate Objective Is Total Disarmament

BY LAURENCE W. MARTIN

A GREAT DEAL of the common stock of ideas about arms control has originated in the Cambridge area from the joint endeavors of those associated with Harvard and M.I.T. It was therefore appropriate that three of the five men on the platform when arms control was discussed on the Centennial weekend were representative of those endeavors. They were Jerome B. Wiesner, who is now Scientific Adviser to the President, Paul M. Doty, Professor of Chemistry at Harvard, and Richard S. Leghorn, '39, President of Itek. Mr. Leghorn provided the day's spot news by announcing that the Centennial Week had inspired him that morning to raise the money for an institute for the study of world security arrangements. Completing the panel were Herman Kahn of the Rand Corporation and, a voice from another age, Philip Noel-Baker, Nobel Peace Prize winner and for more than 40 years an indefatigable advocate of disarmament.

A group brought together for such an occasion as this can rarely break new ground and this panel was no exception. Yet, as so often when several men in the mainstream of policymaking expound their subjects, the manner of their approach and a phrase here and there serve as a useful indication of the trend of advanced thinking.

Despite the range of attitudes represented, no one would belittle the danger of the existing military situation. These misgivings were most impressively expressed by Mr. Kahn, one of the bluntest and most outspoken men at large. He put his sense of the almost immeasurable potentialities for harm in the misuse of modern technology most vividly when he declared that in designing the weapons of tomorrow he and his colleagues were "looking at problems no man has a right to look at."

For those familiar with the recent course of debate on disarmament and arms control the most striking feature of the afternoon was that every speaker accepted the need to pose comprehensive and total disarmament as the ultimate goal. Some, notably Kahn and Leghorn, could see more value in limited measures as an intermediate stage, while Noel-Baker could see virtually none. But no one quarreled with the final goal. Thus Mr. Leghorn, who has claims to have invented the idea of "stable deterrence"—an unassailable balance based on mutually invulnerable forces—renamed this "transitional deterrence"—in transition, that is, to the elimination of even the most defensive forces.

This seemed the only adequate solution to everyone, although estimates as to the difficulty of attaining it varied widely. Mr. Noel-Baker saw little difficulty; Mr. Kahn could not conceive of reaching agreement on such drastic steps without the stimulus of some major crisis, nuclear accident, or even sizable atomic war. Professor Wiesner felt that only comprehensive schemes could avoid the immense complexity of partial schemes with their inevitably complicated rules and definitions. Professor Doty suggested another argument for the comprehensive approach. Only by proposing such schemes, he thought, could each of the major nations reassure others of its earnestness and display the trend of its thought so as to make possible a "confrontation of policies." No piecemeal approach, Doty suggested, could fail to be overtaken by the pace of military technology.

Another interesting common theme was the conviction that disarmament must be thought of as a dynamic state of affairs. Presumably this thought arises from a sense that we cannot hope permanently to replace all the functions of a progressive arms race and military struggle by a static state of disarmament. Rather there will have to be a set of substitute processes. A number of phrases in which participants referred to the goal they set themselves will serve to illustrate this

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Herman H. Kahn

Paul M. Doty

Philip John Noel-Baker

Richard S. Leghorn, '39

Louis I. Kahn

Howard Mumford Jones

Lukas Foss

Richard Lippold

The Arts in the Future: Will Science Change Them?

BY ROBERT R. RATHBONE

FOUR distinguished disciples of the arts—a composer, a philosopher-critic, an architect, and a sculptor—assembled in Kresge Auditorium on April 8 to discuss "The Future of the Arts in a World of Science." They were Lukas Foss, Professor of Music, University of California (Los Angeles); Howard Mumford Jones, Lowell Professor of Humanities, Harvard University; Louis I. Kahn, Chief Critic of Advanced Architectural Design, Yale University; and Richard Lippold, sculptor and Assistant Professor of Art, Hunter College. Dean Pietro Belluschi of the M.I.T. School of Architecture and Planning was the moderator.

Before introducing the speakers, Dean Belluschi referred to the reports on the International Conference on Scientific and Engineering Education, given the previous day. Each report, he observed, had a common thread: a vital concern for human destiny and the human spirit. This concern, he pointed out, justified the choice of the topic for discussion.

Howard Mumford Jones, the first speaker, asked, "Why is it assumed that the future is going to be a world of science?" The triumph of science at some future time, he said, has been announced on several occasions in world history, but such science as we have is at the mercy of politics, decline of population, war, and the alternating beat of Yin and Yang. He then pointed out that if the problem really is "how shall art deal with science?" what we mean by science must be clearly stated. Does the term include pure science only, or pure science plus applied science, the philosophy of science, technology and engineering, medicine and psychology, and perhaps even the pseudoscience of advertising? Professor Jones said he believes that art will deal with all the problems that these fields impose as it has dealt with them in the past: "It will continue to operate in terms of youth, maturity, old age, and death; in terms of love, hate, awe, fear, reverence, and pity."

The real change that science has made and will continue to make in art is in its expression, not in its nature or its task, he suggested. Modern science, for example, is the product of an urban culture that has developed a kind of "horror of wildness," and this attitude, Professor Jones said, appears in the arts. Fortunately, it has altered only the vocabulary of art and not its age-old themes. He concluded by quoting from Sandburg's *Four Preludes on Playthings of the Wind* and by noting that it is well to be humble even before the triumphs of science.

The next speaker, Lukas Foss, began by poking a little fun at the modern composer. Today, the composer likes to be regarded as a scientist, Professor Foss said, and he has adopted such a highly technical vocabulary that at times he is unintelligible and ridiculous. In addition, his approach to artistic invention is a scientific approach, and his training involves more and more technical subjects, such as information theory and acoustics. Many believe that this influence will produce a generation of "scientific composers" who rely solely upon technique to create their art. But Professor Foss is less pessimistic. He believes that there is no reason to hold that great music must be invented only by intuition. The ideal is a wedding of the intuitive and analytical minds, he added, and the scientific composer will not be successful unless his technique is an inspired technique.

Professor Foss believes that the main difference between the artist and the scientist is that the artist wants to build a monument and the scientist is interested in self-enlightenment. Both are rational beings; both have much in common. Except for the difference of purpose, the frontier between the artist and the scientist is hardly discernible.

Third to speak was Richard Lippold. He commented first on what

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Industry in the Future: Will Man's Role Change?

BY JOHN POMFRET

Edwin H. Land

William Oliver Baker

Frank Pace, Jr.

William H. Whyte

TECHNOLOGICAL change is swiftly remaking the industrial face of America. That it will remold the life of industrial man as well seems a certainty. In the process, the great need will be for the broad-gauged, creative, flexible man. Developing him will be a difficult task requiring substantial changes in the present industrial environment.

Those were some of the impressions that emerged from the M.I.T. Centennial panel that considered "The Life of Man in Industry." The participants were William O. Baker, Vice-President—Research, of the Bell Telephone Laboratories; Edwin H. Land, Institute Professor and Chairman of the Polaroid Corporation; Frank Pace, Jr., Chairman of the General Dynamics Corporation; and William H. Whyte, author of *The Organization Man*. Dean Howard W. Johnson of the School of Industrial Management was the panel's chairman.

Dr. Pace began the discussion by posing the "compelling question" of whether industry today is producing the kind of men needed to see the nation through the next half century, not just in terms of industry's requirements, but in terms of those of the nation as well. His answer was no.

Such a man, according to Dr. Pace, should be informed, aware, and able to react quickly to a world in flux. Technological change will bring with it "better people, a higher standard of living, and will permit us to remain competitive throughout the world." But, it also will pose problems of a complexity heretofore unconfronted—problems that new talents will be needed to solve.

As a nation, Dr. Pace observed, we have not been remarkably perceptive and understanding toward those affected by technological change. The first victim was the farmer, who learned that all of the old traditional American qualities of thrift and hard work did not guarantee survival. Now we are in the midst of enormous industrial technological change, and must realize that the broad responsibility to think out the problems of those affected by it "lies with us totally as a people." There will be need for reassessment in both the political and economic arenas. We will have to ask whether our old system of checks and balances is "an anchor in a sailing race against the Communist system," and will have to take a look at our tax and social security systems.

In facing our responsibilities abroad, Dr. Pace said, we will need political, cultural, and scientific maturity. "Underdeveloped nations are looking to us for the capacity to stay on top . . . They are also looking to us not just to give them something, but to give it wisely. Finally, they look to us for a sense of understanding, of community; not a sense of condescension." Since ours is, and is going to be, a free enterprise system, the problem falls squarely on whether the system is capable of changing to produce the kind of man who will be needed.

Dr. Baker declared that managers, particularly executives, and union leaders, recognize too little of the dramatic flux of technology and the changes it is bringing. The time has passed, he said, when we can speak of "a life of man in industry." The location of new plants along superhighways is symbolic. They are no more than stopping places. They no longer capture any real part of the lives of those who work in them. Even so, industry still is devoted anachronistically to the concept that man will live his life in it.

It is now possible, Dr. Baker pointed out, to design machines instead of men for purposes of production. But the change has come with such rapidity that it has been missed by many managers and union leaders. Managers still believe that skills must be developed for the manufacture of their specific product. Not so, said Dr. Baker. Training now must prepare men for

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Physics in the Future: Will It Be Monotonous?

BY ROBERT TOTH

WE LIVE in a heroic age in the physical sciences, one that will be looked at with great jealousy in times to come. America could be discovered only once; so, too, the fundamental laws of physics can be discovered only once. The situation now is pregnant.

Thus Professor Richard P. Feynman, '39, theoretical physicist at California Institute of Technology, sees the future of the physical sciences. The other three distinguished panelists who discussed the issue with him on an M.I.T. Centennial panel April 8 shared his view that they are in the midst of a brilliant dawn of discovery. Professor Francis E. Low of M.I.T.'s Department of Physics introduced the speakers.

By assessing the past and extrapolating into the future, they addressed themselves to the question: How long will the dawn last? History does not repeat itself—or perhaps the only lesson learned from history is that no lesson is learned from history—but a look at the 60 elapsed years of this century shows three profound discoveries: special and general relativity theories and quantum mechanics.

Will this pace of fundamental discovery continue unabated? Will it increase? Or will it peter out into the filling of gaps left as the great giant of discovery strides forward? Or will the game end abruptly in one burst of all-illuminating light?

"It is possible," Professor Feynman said, "that there is a final solution," a final unifying law that will explain all of the diverse physical effects seen in the nucleus and the cosmos.

The giant of science is advancing on two feet, one experimental, the other theoretical, he said. The experimental leg at this point in time is far ahead. It has flushed out the profusion of elementary sub-nuclear particles which theorists are at a loss to explain. This giant is now running through a long and darkened building, Dr. Feynman's analogy continued. It may seem to have no ending, only a series of doors each of which must be opened in turn. But it is unwarranted pessimism to say now that there is no single, final door which opens to light. Only if the fundamental laws of physics change with absolute time—and he suggested that this was also a possibility—would there be no final answer.

Professor Chen Ning Yang of the Institute for Advanced Study in Princeton disagreed. He saw an infinite number of doors in the future. "The depth of natural phenomena is limitless," this young Nobel Prize winner said. When all other questions are answered, man will still be faced with the ultimate one: "How do we understand that we understand?" Even before that, after man has formulated laws regarding how things work, he must cope with such problems as "what is a magnetic field?"

"But even that can't go on forever," said Professor R. E. Peierls, a mathematical physicist from the University of Birmingham in England. Magnetic fields today are explained in terms of hydrodynamics dependent on the actions of molecules. Below molecules are atoms and nuclei, whose actions depend on magnetic fields to some extent. So we come full circle, he said. Once magnetic fields are explained fully, the circle will be forever broken.

While the panelists could not agree—perhaps on philosophical grounds—on the probable end of the road of discovery, they thought they could see relatively clearly what the next few strides along that road might be.

"The rapid widening of knowledge will continue," Dr. Yang predicted. In nuclear physics, he expects

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Richard Feynman, '39, speaking with (from left) Sir John Cockcroft, Chen Ning Yang, Francis Low, and R. E. Peierls.

Dr. Beadle speaking on panel with (left to right) Hermann J. Muller, Alexander Rich, Jonas Salk, and Peter B. Medawar.

Biology in the Future: Will People Be Improved?

BY ROBERT TOTH

WHY aren't Siamese cats all black? And how does seaweed know which way is up? These questions were posed by Dr. George W. Beadle, Chancellor of the University of Chicago, in opening the panel on the life sciences, presided over by Professor Alexander Rich at M.I.T.'s Centennial on April 8. Dr. Beadle's answers to his questions illustrated the momentous advances made by biologists during the last decade.

Siamese cats are black only at their extremities—the ears, tail, feet, and nose—because those are the coolest parts of their bodies. The agent which makes black pigment will not function at the slightly higher temperatures in other areas of their bodies. Both the precursor of the pigment, and the agent (enzyme) which converts it to pigment, are manufactured by cells from blueprints carried in the genes of the cells.

While genes play this vital role in life, environment is important, too, Dr. Beadle indicated. The bulge in the egg of embryonic seaweed, from which the roots that shoot downward grow, can be induced at any location on the surface of the egg by such environmental factors as visible and ultraviolet light, oxygen concentration, temperature, and chemicals.

Thus both heredity and environment play roles in the development of life. But how do they do it? Here, too, he had some answers, but the answers suggested other questions for future biologists and geneticists.

The most fundamental question at this juncture in biology's development is: How does a cell know what its job is? It carries in the genes the blueprints for making anything the body needs. Any single cell has information which, if used, could make it develop into a liver cell or a brain cell rather than one that produces pigment, for example. Dr. Beadle likened the cell's genetic store to a cookbook: it contains all possible recipes, but only one or a few are selected for use. How this selection is made is the next big question.

Professor Hermann J. Muller of Indiana University looked beyond the solution. To him, biologists have reached the threshold of a benign "Brave New World." The bare essentials by which life can be artificially created and by which one species may be changed into another already have been obtained, he said, although "most scientists, even most biologists, are not yet aware" of it. He cited the production of a gene-like chain of molecules capable of replicating itself as proof that life can be created. He saw man-induced changes in genes as examples of his ability to change species, however slightly.

But men will "not be satisfied forever with gaining knowledge without using it," Professor Muller commented. Once they tie the action of genes to the specific changes they produce, men will seek to repair deficiencies in the body by curing diseases. After that, they will look to making a man out of whole cloth, free of mistakes inherent in "this house that Jack the gene built."

"The biology of the future will increasingly be one of studying what arrangements would be better and how they may be achieved. . . . (Biology) will turn to the never ending task of creation," he said. But he saw no danger in this. "We need not fear that men will move in a direction contrary to that of life itself, or of our own deepest yearnings."

Professor Peter B. Medawar of University College in London took up the issue of eugenics. His thoughts on improving man were

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Delegates to the Centennial Convocation

REPRESENTATIVES of schools and other organizations at the Centennial Convocation were:

Oxford University: XIIIth Century
SIR HAMILTON ALEXANDER ROSSKEEN GIBB, *Professor*

Université de Paris à la Sorbonne: XIIIth Century
RAYMOND CLAUDE FERDINAND ARON, *Professor*

University of Cambridge: XIIIth Century
CHARLES OSCAR BRINK, *Professor*

Ruprecht-Karl Universitat (Heidelberg): 1386
CARL FRIEDRICH

Université Catholique de Louvain: 1425
GEORGES LEMAITRE, *Professor*

Glasgow University: 1451
JOHN CURRIE GUNN, *Professor*

Istanbul Universitesi: 1453
SIDDIK SAMI ONAR, *Professor*

Kungliga Universitet i Uppsala: 1477
OLOV W. FRYCKSTEDT, *Professor*

Universidad Nacional Autonoma de Mexico: 1551
MANUEL SANDOVAL VALLARTA, *Professor*

Dublin University: 1591
FRANCIS C. COULTER

University of Santo Tomas: 1611
PAULINO JACINTO GARCIA

City of Boston: 1630
JOHN F. COLLINS, *Mayor*

City of Cambridge: 1630
EDWARD ALFRED CRANE, *Mayor*
JOHN J. CURRY, *City Manager*

Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique: 1636
HARLOW SHAPLEY

Harvard University: 1636
NATHAN MARSH PUSEY, *President*

Royal Society of London: 1660
HENRY GEORGE THODE

College of William and Mary: 1693
WILLIAM GEORGE GUY, *Professor*

St. John's College: 1696
RICHARD DANIEL WEIGLE, *President*

Yale University: 1701
KINGMAN BREWSTER, *Provost-Designate*

Academy of Sciences of the U.S.S.R.: 1725
LEONID IVANOVICH SEDOV, *Vice President*

University of Pennsylvania: 1740
GAYLORD P. HARNWELL, *President*

The American Philosophical Society: 1743
HENRY ALLEN MOE, *President*

Princeton University: 1746
HENRY DE WOLF SMYTH, *Professor*

Washington and Lee University, 1749
EDMUND LEE GAMBLE

Columbia University: 1754
GRAYSON KIRK, *President*

Moscow State University: 1755
G. G. CHERNYI, *Professor*

Brown University: 1764
BARNABY CONRAD KEENEY, *President*

Rutgers University: 1766
ELMER CHARLES EASTON, *Dean*

Dartmouth College: 1769
LEONARD MOOS RIESER, JR., *Deputy Provost*

Istanbul Teknik Universitesi: 1773
FIKRET NARTER, *Rector*

Phi Beta Kappa: 1776
KIRTLEY FLETCHER MATHER

Commonwealth of Massachusetts: 1780
JOHN ANTHONY VOLPE, *Governor*

Royal Society of Edinburgh: 1783
IAN NAISMITH SNEDDON

University of New Brunswick: 1785
COLIN BRIDGES MACKAY, *President*

Royal Irish Academy: 1786
NEIL A. PORTER

Royal Swedish Academy of Sciences: 1786
TORBJORN CASPERSSON

Franklin and Marshall College: 1787
CLAUDE ALVIN VILLEE

University of Pittsburgh: 1787
BENJAMIN MORRIS SELEKMAN, *Professor*

Washington and Jefferson College: 1787
FRANCIS BEGNAUD HILDEBRAND

Georgetown University: 1789
FRANCIS LEE SWIFT

University of Vermont: 1791
JOHN T. FEY

Williams College: 1793
RALPH PHILIP WINCH, *Professor*

Bowdoin College: 1794
JAMES STACY COLES, *President*

L'Ecole Polytechnique: 1794
PHILIPPE GOURAUD

The University of Tennessee: 1794
GRADY CURTIS HOLT

Union College: 1795
CARTER DAVIDSON, *President*

Middlebury College: 1800
SAMUEL SOMMERVILLE STRATTON, *President*

United States Military Academy: 1802
JOHN DABNEY BILLINGSLEY, *Professor*

University of Maryland: 1807
FREDERIC THEODORE MAVIS, *Dean*

Koninklijke Nederlandse Akademie van Wetenschappen: 1808
NICOLAAS BLOEMBERGEN

Universitetet i Oslo: 1811
PAUL GRUDA KOHT

Hamilton College: 1812
BREWSTER HUNTINGTON GERE, *Professor*

Colby College: 1813
ROBERT WHITE PULLEN, *Professor*

University of Michigan: 1817
HARLAN HENTHORNE HATCHER, *President*

Dalhousie University: 1818
ALEXANDER ENOCH KERR, *President*

Engineering Societies of Great Britain—Institution of Civil Engineers: 1818
Institution of Mechanical Engineers: 1847
Institution of Electrical Engineers: 1871
Institution of Chemical Engineers: 1922
SIR WILLIS JACKSON

St. Louis University: 1818
KEVIN BRIAN HARRINGTON

Colgate University: 1819
HORTON GUYFORD STEVER

Leningrad State University: 1819
YURI VICTOROVICH NAVOZHILOV, *Vice Rector*

University of Cincinnati: 1819
HOWARD KENNETH JUSTICE, *Dean*

University of Virginia: 1819
NEAL OSGOOD WADE, JR.

Indiana University: 1820
HERMAN B. WELLS, *President*

Amherst College: 1821
CHARLES SCOTT PORTER, *Dean*

George Washington University: 1821
CHARLES YARDLEY CHITTICK

McGill University: 1821
JOHN STUART FOSTER, *Professor*

Universidad de Buenos Aires: 1821
WILLIAM LESLIE CHAPMAN, *Vice Rector*

Hobart and William Smith Colleges: 1822
OLCOTT M. BROWN

Trinity College: 1823
WENDELL EVERETT KRAFT

Kenyon College: 1824
CHARLES RAY RITCHESON, *Professor*

Rensselaer Polytechnic Institute: 1824
RICHARD GILMAN FOLSOM, *President*

Technische Hochschule Fridericiana (Karlsruhe): 1825
HANS LEUSSINK, *Rector*

Lafayette College: 1826
EUGENE HOWARD CLAPP, *President*

Western Reserve University: 1826
WEBSTER GODMAN SIMON, *Vice President*

Chief Marshal David A. Shepard, '26, headed the academic procession.

The University College of Sierra Leone: 1827
DAVIDSON NICOL, *Principal*

University of Toronto: 1827
CLAUDE T. BISSELL, *President*

Chalmers Tekniska Högskola: 1829
NILS GUSTAV JOSEF GRALEN, *Professor*

Danmarks Tekniske Hojskole: 1829
EGGERT KNUTH-WINTERFELDT, *President*

Universidad Mayor San Andres: 1830
ISMAEL ESCOBAR

New York University: 1831
CARROLL VINCENT NEWSOM, *President*

Wesleyan University: 1831
EARL PLACE STEVENSON

University of Durham: 1832
CHARLES ION CARR BOSANQUET, *Vice-Chancellor*

Haverford College: 1832
RUSSEL GREENE ALLEN

Oberlin College: 1833
ROBERT TAYLOR COLE, *Professor*

Norwich University: 1834
ELMER L. MUNGER, *Professor*

Université Libre de Bruxelles: 1834
LOUIS GROVEN

University of Delaware: 1834
JOHN ALANSON PERKINS, *President*

Tulane University: 1834
MOISE HERBERT GOLDSTEIN, JR., *Professor*

Wheaton College: 1834
ELIZABETH STOFFREGEN MAY, *Acting President*

Emory University: 1836
MAX HALL

Ethnikon Metsovion Polytechneion (Athens): 1836
ELIAS PANAYIOTIS GYFTOPOULOS

University of London: 1836
ERIC GARDNER TURNER, *Professor*

Mount Holyoke College: 1837
RICHARD GLENN GETTELL, *President*

Duke University: 1838
JULIAN DERLY HART, *President*

Boston University: 1839
HAROLD CLAUDE CASE, *President*

Virginia Military Institute: 1839
JAY SANDLES GRUMBLING

Fordham University: 1841
JOSEPH F. MULLIGAN, S.J., *Professor*

Ohio Wesleyan University: 1841
DAVID FRANK EDWARDS

Queen's University at Kingston: 1841
BERNICE WELDON SARGENT, *Professor*

University of Notre Dame: 1842
THEODORE MARTIN HESBURGH, C.S.C., *President*

Technische Hogeschool te Delft: 1842
OENE BOTTEMA, *Professor*

College of the Holy Cross: 1843
RAYMOND J. SWORDS, S.J., *President*

The Queen's University of Belfast: 1845
PAUL P. EWALD, *Professor*

United States Naval Academy: 1845
GEORGE LEVICK STREET, III

University of Buffalo: 1846
JOHN DI GIORGIO

Grinnell College: 1846
JOHN FORREST CHAPMAN

Smithsonian Institution: 1846
LEONARD CARMICHAEL, *Secretary*

American Medical Association: 1847
NORMAN ALPHONSE WELCH

The City College of the College of the City of New York: 1847
HOWARD BLATT

Koninklijk Instituut van Ingenieurs: 1847
PIETER HONIG

State University of Iowa: 1847
VIRGIL MELVIN HANCHER, *President*

Werner W. Jaeger (left), Abdul Abdullah, '46, and Ram Gopal Chatterji in the procession.

Societé des Ingenieurs Civils de France: 1848
GERARD DE PIOLENE, *Vice President*

University of Wisconsin: 1848
FREDERICK JOHN STARE

University of Rochester: 1850
CORNELIS WILLEM DE KIEWIET, *President*

University of Utah: 1850
STANLEY SMITH STEVENS

University of Minnesota: 1851
JAMES JOSEPH LINGANE

Northwestern University: 1851
HAROLD BENEDICT GOTAAS, *Dean*

Ripon College: 1851
FREDERICK OLIVER PINKHAM, *President*

American Society of Civil Engineers: 1852
FRANK ALWYN MARSTON

Antioch College: 1852
MILTON CHARLES WASBY

L'Université Laval: 1852
LOUIS-PHILIPPE BONNEAU, *Dean*

Mills College: 1852
FLORA BELLE LUDINGTON

Tufts University: 1852
ASHLEY SAWYER CAMPBELL, *Dean*

Cornell University: 1853
DEANE W. MALOTT, *President*

Manhattan College: 1853
AUGUSTINE PHILIP, *President*

University of Melbourne: 1853
WILLIAM WOODRUFF, *Professor*

St. Francis Xavier University: 1853
HUGH JOSEPH SOMERS, *President*

Washington University: 1853
STEPHEN SPIEGELGLAS, *Professor*

Polytechnic Institute of Brooklyn: 1854
ERNST WEBER, *President*

Eidgenössische Technische Hochschule, (Zürich): 1855
ALBERT ESCHENMOSER, *Professor*

Michigan State University: 1855
WILLIAM JAMES CLENCH

Pennsylvania State University: 1855
MERRITT ALVIN WILLIAMSON, *Dean*

St. Lawrence University: 1856
GUILFORD WHITNEY FORBES

University of Bombay: 1857
BAL DADDRAYA TILAK, *Professor*

University of the South: 1857
RICHARD STILLWELL CORRY

Iowa State University of Science: 1858
MORRIS S. COOPER, *Dean*

The Cooper Union: 1859
HERBERT F. ROEMMELE, *Professor*

Louisiana State University and Agricultural and Mechanical College: 1860
RICHARD BRIAN DARST

Swedish Association of Engineers and Architects: 1861
PELLE ISBERG

Vassar College: 1861
SARAH GIBSON BLANDING, *President*

University of Washington: 1861
NORMAN CHRISTIAN DAHL

Boston College: 1863
MICHAEL PATRICK WALSH, S.J., *President*

University of Massachusetts: 1863
JOHN WILLIAM LEDERLE, *President*

Politecnico di Milano: 1863
GINO BOZZA, *Rector*

Robert College: 1863
HAROLD LOCKE HAZEN, *President (Interim)*

Bates College: 1864
ROBERT STANTON IRELAND

University of Denver: 1864
DONALD HOWARD MENZEL

Marquette University: 1864
JACK BRUCE GREENE, *Professor*

Swarthmore College: 1864
ARTHUR F. F. SNYDER

Lehigh University: 1865
HARVEY ALEXANDER NEVILLE, *Vice President and Provost*

University of Maine: 1865
WESTON SUMNER EVANS, *Dean*

Purdue University: 1865
PAUL FRANKLIN CHENEA, *Professor*

Worcester Polytechnic Institute: 1865
ARTHUR BROUGH BRONWELL, *President*

American University of Beirut: 1866
SALWA NASSAR, *Professor*

Carleton College: 1866
PATRICK ANDERSON REQUA

University of Kansas: 1866
PATRICIA H. BENEDICT

University of New Hampshire: 1866
ELDON LEE JOHNSON, *President*

College of Wooster: 1866
WILSON MARTINDALE COMPTON

Howard University: 1867
JULIA HAMILTON SMITH

Technische Hochschule München: 1867
GUSTAV AUFHAMMER, *Rector*

University of Illinois: 1867
PHILIP LOUIS MILLER

West Virginia University: 1867
WALTER WARREN POINT

University of California: 1868
JOHN GRISSIM PIERCE, *Professor*

Wayne State University: 1868
GEORGE ALBERT HANNA

University of Nebraska: 1869
MERK HOBSON, *Dean*

Hunter College: 1870
MINA REES, *Dean*

Missouri School of Mines and Metallurgy: 1870
CURTIS LAWS WILSON, *Dean*

Ohio State University: 1870
HENRY HESS BLAU, JR.

Stevens Institute of Technology: 1870
JESS HARRISON DAVIS, *President*

Syracuse University: 1870
WILLIAM ALBERT ROTUNNO

Rheinisch-Westfälische Technische Hochschule (Aachen): 1870
HERWART OPITZ, *Professor*

Wellesley College: 1870
MARGARET CLAPP, *President*

American Institute of Mining, Metallurgical and Petroleum Engineers, Inc.: 1871
RONALD RUSSEL MCNAUGHTON, *President*

Smith College: 1871
GEORGE DE VILLAFRANCA, *Professor*

Texas Agricultural and Mechanical College: 1871
CARL B. STERZING, JR.

Teknillinen Korkeakoulu, Helsinki: 1872
ERKKI AUKUSTI LAURILA, *Professor*

Vanderbilt University: 1872
HARVIE BRANSCOMB, *Chancellor*

Colorado College: 1874
DONALD SKEELE TUCKER

Norske Ingeniorforening, Den: 1874
NILS CHRISTENSEN

Rose Polytechnic Institute: 1874
JOHN BLAIR SHANNON

American Chemical Society: 1876
ARTHUR CLAY COPE, *President*

The Johns Hopkins University: 1876
RICHARD S. LORD, *Professor*

Université de Montréal: 1876
IRENEE LUSSIER, *Rector*

University of Oregon: 1876
GORDON RAY JULIAN

American Bar Association: 1878
OSMER CUSHING FITTS

Radcliffe College: 1879
MARY INGRAHAM BUNTING, *President*

The American Society of Mechanical Engineers: 1880
WILLIAM FRANCIS RYAN

Case Institute of Technology: 1880
JOHN ANTHONY HRONES, *Vice President*

Newark College of Engineering: 1881
MICHAEL DOUGLAS BENEDICT

Tuskegee Institute: 1881
ZBIGNIEUW WLADYSLAW DYBCZAK, *Dean*

University of Connecticut: 1881
VINTON BENJAMIN HAAS, JR., *Acting Dean*

University of Texas: 1881
FRANK L. TUCKER

Royal Society of Canada: 1882
MERTON YARWOOD WILLIAMS, *President*

Modern Language Association: 1883
HOWARD MUMFORD JONES

American Historical Association: 1884
ALFRED DU PONT CHANDLER, JR.

American Economic Association: 1885
EDWARD SAGENDORPH MASON

Bryn Mawr College: 1885
KATHERINE ELIZABETH MCBRIDE, *President*

Georgia Institute of Technology: 1885
EDWARD EMIL DAVID, JR.

Stanford University: 1885
STANLEY SMITH STEVENS, *Professor*

The Tau Beta Pi Association: 1885
JOHN AVERY TUCKER

North Carolina State College of Agriculture and Engineering: 1886
JOHN TYLER CALDWELL, *Chancellor*

The Society of Sigma Xi: 1886
WALLACE REED BRODE, *President*

The Catholic University of America: 1887
TIMOTHY FRANCIS O'LEARY

Clark University: 1887
HOWARD BONAR JEFFERSON, *President*

McMaster University: 1887
JOHN WILLARD HODGINS, *Dean*

Pomona College: 1887
MILTON STANLEY LIVINGSTON

Pratt Institute: 1887
ROY HERBERT COOK, *Dean*

American Mathematical Society: 1888
IRVING EZRA SEGAL

California Institute of Technology: 1891
LEE ALVIN DUBRIDGE, *President*

Drexel Institute of Technology: 1891
LEROY ARGLUS BROTHERS, *Dean*

William Marsh Rice University: 1891
WILLIAM VERMILLION HOUSTON, *Chancellor*

Illinois Institute of Technology: 1892
HAROLD G. INGRAHAM

The University of Chicago: 1892
GEORGE WELLS BEADLE, *Chancellor*

University of Oklahoma: 1892
ROBERT CALVERT

University of Rhode Island: 1892
FRANCIS HENRY HORN, *President*

The Society of Naval Architects and Marine Engineers: 1893
G. BAER CONNARD

Lowell Technological Institute: 1895
MARTIN JAMES LYDON, *President*

Kyoto University: 1897
YASUYUKI OTANI, *Professor*

Northeastern University: 1898
ASA SMALLIDGE KNOWLES, *President*

American Physical Society: 1899
KARL KELCHNER DARROW, *Secretary*

Simmons College: 1899
ELEANOR CLIFTON, *Dean*

Birmingham University: 1900
RUDOLF PEIERLS, *Professor*

Norges Tekniske Hogskole: 1900
LEIF NORROLF PERSON, *Professor*

American Philosophical Association: 1901
CORNELIUS KRUSE, *Chairman*

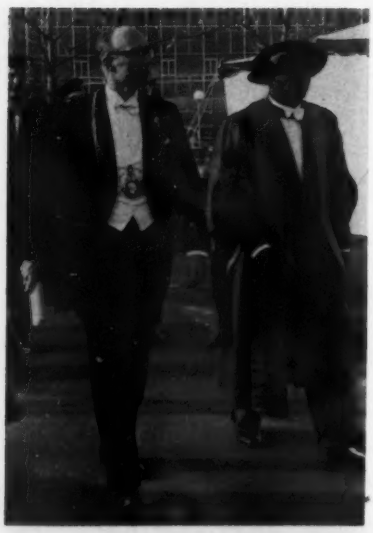
The Rockefeller Institute: 1901
DETLEV WULF BRONK, *President*

Leningrad Polytechnic Institute: 1902
L. G. LOITSIANSKI, *Professor*

Waseda University: 1902
JOHN KAZUO MINAMI, *Professor*

University of Liverpool: 1903
SIR HUGH TAYLOR, *Professor*

University of Puerto Rico: 1903
JAIME BENITEZ, *Chancellor*



Eggert Knuth-Winterfeldt, President of Danmarks Tekniske Hojskole, and Davidson Nicol, Principal of University College of Sierra Leone.

American Sociological Association: 1905
TALCOTT PARSONS

Imperial College of Science and Technology: 1907
PATRICK MAYNARD STUART BLACKETT, *Professor*

University of Hawaii: 1907
KENICHI WATANABE, *Professor*

American Institute of Chemical Engineers: 1908
JOHN JOSEPH HEALY, *President*

University of the Philippines: 1908
MELQUIADES J. GAMBOA

University of British Columbia: 1908
JOHN JAMES CONWAY

Indian Institute of Science: 1909
MANEKAL SANKALCHAND THACKER, *Professor*

National University of Ireland: 1909
THOMAS PATRICK MITCHELL

Reed College: 1909
DAVID FRENCH, *Professor*

University of Saskatchewan: 1909
WALTER GRANT MAY

Connecticut College: 1911
ROSEMARY PARK, *President*

Southern Methodist University: 1911
PAUL K. DEATS

Institute of Radio Engineers: 1912
RONALD LYMAN MCFARLAN

Technion—Israel Institute of Technology: 1912
JOSEPH BEN SIMHA BRAVERMAN, *Professor*

American Council of Learned Societies: 1919
WERNER WILHELM JAEGER

American Geophysical Union: 1919
THOMAS FRANCIS MALONE, *Vice President*

American Meteorological Society: 1919
JAMES MURDOCH AUSTIN, *Secretary*

Babson Institute of Business Administration: 1919
BRYCE PRINDLE

Institute of Technology of the Air University of the United States Air Force: 1919
CECIL E. COMBS, *Commandant*

New School for Social Research: 1919
HENRY DAVID, *President*

University of Alaska: 1922
TERRIS MOORE, *Professor*

Social Science Research Council: 1923
PENDLETON HERRING, *President*

Linguistic Society of America: 1924
ROMAN JAKOBSON

Bennington College: 1925
KENT DE LANCE LAWSON

Texas Technological College: 1925
JOHN RALPH HAVIS

Sarah Lawrence College: 1926
CHARLOTTE HOUTERMANS

National Taiwan University: 1928
WEN YEN TSAO, *Professor*

Institute for Advanced Study: 1930
ERIC G. TURNER, *Professor*

American Institute of Physics: 1931
ELMER HUTCHISSON, *Director*

University of Teheran: 1935
ABOLGHASSEM GHAFFARI

Institute of Food Technologists: 1939
IMRI J. HUTCHINGS, *President*

Australian National University: 1946
WILLIAM IRVING BERRY SMITH

University College, Ibadan (Nigeria): 1947
ENI NJOKU, *Professor*

Brandeis University: 1948
LOUIS LEVIN, *Dean*

University of New South Wales: 1948
HAROLD RUPERT VALLENTINE, *President*

Weizmann Institute of Science: 1948
ABBA EBAN, *President*

University College of the West Indies: 1949
WILLIAM ARTHUR LEWIS

Institute of Technology, Kharagpur: 1951
RAM GOPAL CHATTERJI

Polish Academy of Sciences: 1952
ZDENEK LOUDA

U. S. Air Force Academy: 1955
GERHARDT CHRISTOPHER CLEMENTSON, *Professor*

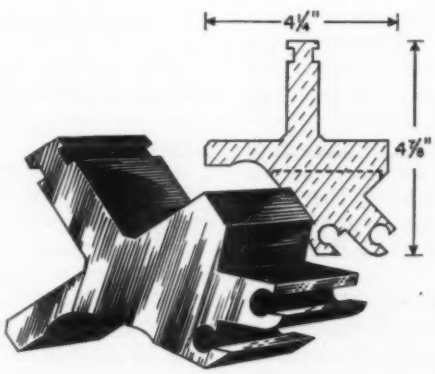
University of Baghdad, 1958
ABDUL ABDULLAH, *President*

BUSINESS IN MOTION

To our Colleagues in American Business . . .

The extruded copper section sketched below is used in a low-voltage circuit breaker made by one of the country's leading electrical equipment manufacturers.

Originally it was two extrusions brazed together as shown by dotted line. However, it was reasoned, if it could be made as a single extrusion a number of operations would be saved. At first that procedure appeared to be impractical in a copper extrusion as intricate and heavy as this (piece of it only 3 7/16" long, measuring 4 1/4" x 4 7/8", weighs eight pounds, seven ounces). But the possibility was believed to be worth investigating.



Through close collaboration between the manufacturer's engineering department and the Revere Methods and Production Departments, it was found possible to combine these two sections into a single extrusion. Work was started, dies were made and test runs conducted. The tooling (for hot extrusion was followed by cold drawing) also posed some special problems. It had to be both rugged and precise in order to produce this monster extrusion to the manufacturer's exacting specification requirements.

Finally, a sample extrusion was delivered to the customer for testing and found to be right in every way.

Not only does this Revere Copper Extrusion eliminate much costly machining in the customer's plant, but it obviates the need to purchase separate extrusions and braze them together. An extra benefit was gained in the form of longer life for the new extrusion, because the heat required to join the two pieces used originally had tended to soften the built-up unit and thus shortened its useful life.

So, while some problems may seem virtually insoluble at first, why not explore the possibilities by doing as this leading manufacturer did . . . call on the Revere Technical Advisory Service? In that way, by "fitting the metal to the job," Revere may be able to help you to cut costs, produce a superior product, or both.

In fact, it generally pays to adopt that principle with all suppliers—take them into your confidence; thus add their abilities and experience to your own.

REVERE COPPER AND BRASS INCORPORATED
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Executive Offices: 230 Park Avenue, New York 17, N. Y.
Distributors Everywhere

Trend of Affairs

(Continued from page 31)

Neutrons and Magnetic Moments

MAGNETIC phenomena have been observed for centuries, but not until recent decades have the intimate details begun to be uncovered.

The magnetic properties of a material are attributable to the interaction of the electrons of one atom with those of another atom, the "exchange interaction." What is the nature of this exchange interaction?

C. G. Shull, Professor of Physics at M.I.T., has been concerned with this question for the last decade, and in recent years has been directing a research project at the M.I.T. Nuclear Reactor, known as Neutron Diffraction Studies in Solid State Physics. Crystal spectrometers receive beams of neutrons from the reactor core through "beam holes" penetrating the reactor shielding, and the crystal selectively reflects neutrons of specific energies. These neutrons themselves are not of prime interest; rather, they become the tool for studying the exchange interaction.

Consider the body-centered-cubic iron crystal, having atoms at each corner and one in the center. The 26 electrons of an iron atom circle the nucleus in various spatial orbits in addition to spinning around their own axes. This is similar to the rotation of the earth around its own axis as it orbits the sun. The motion of a charged particle constitutes a magnetic moment, and the combined effect of these electronic magnetic moments is an atomic magnetic moment, to which a direction is assigned. Generally, only the outermost electrons contribute to the atomic magnetic moment, the inner electrons occurring in balanced pairs. The alignment of these magnetic moments makes an iron crystal magnetic, and further alignment of adjacent crystals produces a magnetic domain.

In early work in this field, x-rays were used to obtain information regarding the electronic distribution in metal atoms, the x-rays interacting with all the electrons. Why are neutrons helpful? Because they possess magnetic moments, whereas x-rays do not. The neutron magnetic moment interacts with the atomic magnetic moment, and the measurement of the scattering reveals the directional and spatial distribution of the atomic magnetic moments. In particular, since the interactions with the inner balanced pairs of electrons cancel, only the effects of the outermost magnetic electrons are observed, and their characteristics are thus determined.

Theory predicts two preferred locations for the magnetic electrons in a cubic crystal, one along the edge of the cube (octahedral direction) and one along the space diagonal (tetrahedral direction). Experiments show that both magnetic states occur. In the iron crystal, there is some preference for the octahedral state. In the nickel crystal, which is face-centered-cubic, the tetrahedral state is more prevalent. This difference in the preferred locations may be the result of the difference in crystalline structure.

The neutron diffraction spectrometers were built by Professor Shull with a grant from the United States Air Force Office of Scientific Research and the program is supported by the National Science Foundation.

Dr. Bell at work in his new Dorrance Building Laboratory.

A New Laboratory Is Opened

DR. EUGENE BELL, Associate Professor of Biology, and his associates and graduate students moved to the eighth floor of the John Thompson Dorrance Building this spring and thus opened M.I.T.'s newest laboratory. Dr. Bell's group is studying how cells grow, develop, and become different from each other. Dr. Bell himself is best known for his use of ultrasonic radiation to dissociate cells and cell layers and his discoveries regarding the development of limbs in chickens. His new laboratory has a spotless array of equipment, sterile rooms, and instruments for tissue culture and embryological work. Next to it on the newly added eighth floor of the Dorrance Building is a tissue-culture laboratory, to be directed by Dr. James E. Darnell, Jr., who will come to M.I.T. soon from France.

A staff worker in one of the bays of the new laboratory.

(The Trend of Affairs is concluded on page 60)

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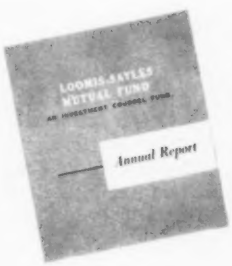
Investment Counsel

140 FEDERAL STREET, BOSTON



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A managed diversified investment portfolio
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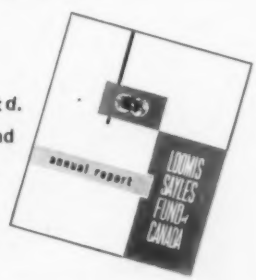
A Canadian and International Growth Fund
Shares available at net asset value



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Trend of Affairs

(Concluded from page 58)

The Future of Homebuilding

AMERICA'S 20-billion-dollar homebuilding industry now uses some prefabricated components such as roof trusses, wall panels, and cabinets, but most of these really are built in traditional ways from traditional materials.

Should there be more integration of the industry, and more use of mass-production methods and new materials? This question leads to others, such as: What combination of components would minimize costs and still permit flexibility in the design of homes? Can custom-designed homes be produced from such components? Will the local builder's role become analogous to that of the automobile dealer?

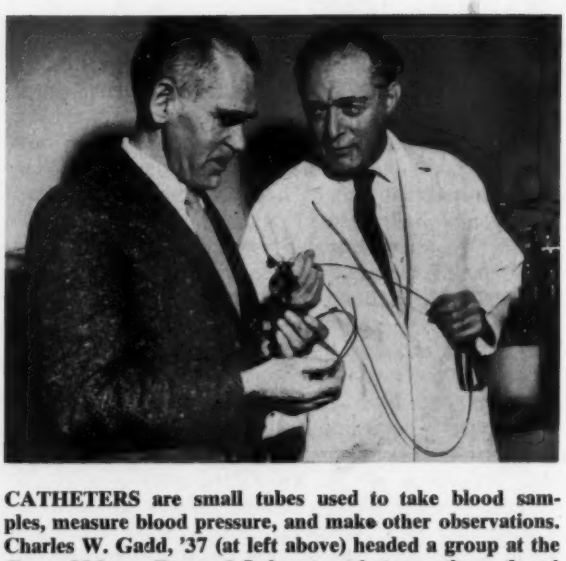
Professor Albert G. H. Dietz, '32, J. Lloyd Cutcliffe, '59, and Allan I. Poms have worked out methods for dealing with some aspects of these questions for the National Association of Home Builders.

They have used the IBM 709 computer at M.I.T., for example, to evaluate various combinations of components. Dimensions of 75 houses, carefully chosen as a sample of those being built throughout the nation today, were fed to the machine along with curves showing the cost of components built to various dimensions. Although no one sharply superior set of components was revealed, the computations did indicate that, in general, the larger and fewer the components were, the less the houses built from them would cost. Effecting such savings, however, could entail sacrifices in design flexibility and in the economical use of floor space.

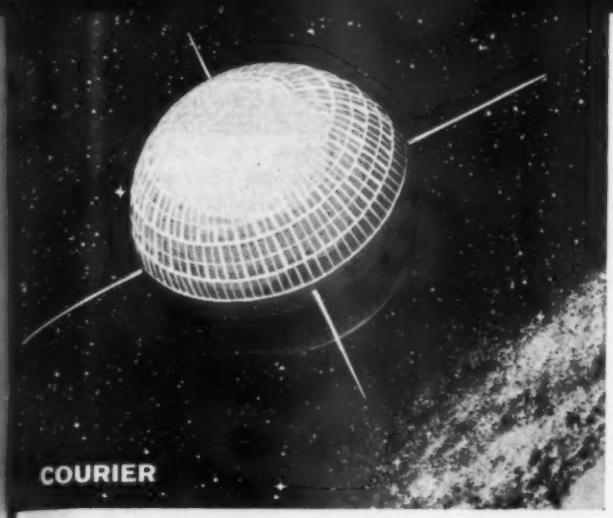
The project also included a study of eight custom-designed houses, which showed that they could be constructed from components without undue distortion if certain sizes were chosen; and a study of current trends in the industry.

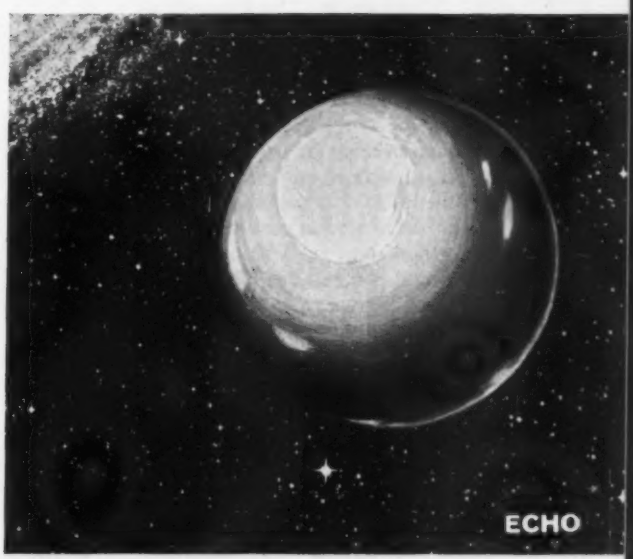
"The construction industry offers an extremely attractive market for large quantities of materials and equipment and is consequently being closely studied by other industries which traditionally have had little or no direct contact with construction," the researchers reported. "A dream or ambition often expressed by component manufacturers is a system in which shell components such as walls and partitions can be produced by a continuous process, often visualized as consisting of a pair of skins or facings proceeding down a conveyer with a core of some kind continuously being produced between the two facings and the three parts of the sandwich simultaneously bonded together. . . . When a continuous sandwich can be cut to any length, and when doors and windows can be spotted in the sandwich as desired, complete flexibility can be attained without the need of an assortment of small components. . . . Other factors, especially equipment, appliances, and fixtures, then would limit the design of the house. . . . It is not at all unlikely that a completely integrated operation will win out unless the homebuilders themselves find ways of acting co-operatively to assure sufficient volume to make it worth while for different manufacturers of materials and equipment to produce the components to be distributed by the local dealer to the local builder."

TO HAUL ENGINES being removed from the Steam Laboratory at M.I.T., a 1914 Pierce Arrow truck was obtained. Both it and the engines are destined to go to the Museum of Steam and Marine Engineering in St. Louis. With about 2300 pounds of machinery loaded on it and a trailer, the truck adorned an M.I.T. parking lot for weeks this spring, awaiting a driver.



CATHETERS are small tubes used to take blood samples, measure blood pressure, and make other observations. Charles W. Gadd, '37 (at left above) headed a group at the General Motors Research Laboratory that recently produced an improved catheter which can be "steered" through the pulmonary artery into the heart's cavities and passageways. Dr. Richard J. Bing (at right) of Wayne State University expects it to be helpful in diagnosing heart ailments.





Philco Achievements in Space Technology

Philco has made many major contributions to the nation's vital space programs. COURIER, the world's first advanced communications satellite, was designed and built by Philco. Philco played a major role in the development and installation of the complex communications, command, tracking and data systems for the DISCOVERER program. Space-borne and ground communications systems for MIDAS and other satellites have been Philco designed. Philco developed and installed the tracking and receiving systems for the Air Force Passive Satellite Relay Link, which utilizes the ECHO satellite. In the field of human factors engineering, Philco has developed personnel subsystems for several major space projects. Philco also produces the world's largest 3-axis satellite tracking antennas.

These achievements are dramatic evidence of Philco's ability to integrate its extensive resources to the design and production of the most sophisticated electronic systems. For capacity, facilities and experience in space technology, look to the leader . . . look to Philco.

Government and Industrial Group, Philadelphia 44, Pennsylvania

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Disarmament Is Objective

(Continued from page 47)

point. Thus for Professor Doty the task was to design "a complex system of operations by which we might achieve very much lower levels of arms, with stability at each level." Mr. Leghorn looked for "world arrangements for security from armed violence." Professor Wiesner, in turn, conceived of "the organization of world society in a way which would make it unnecessary to live under the threat of war."

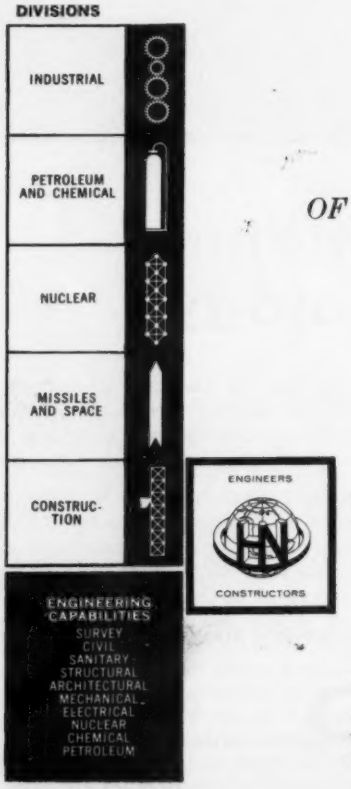
Each speaker surveyed some of the obstacles on the road toward these goals. Professor Doty dwelt chiefly upon the developments by which we have reached our present dilemmas. Destructive capacity had multiplied a thousandfold in 1945 and a thousandfold again in 1953. The problem is the unresolved one of adapting human behavior to this revolution. So far we have been content with the traditional response of multiplying our armaments—a policy fatal to the values we wish to protect. We should proceed flexibly, but with an over-all strategy, to consider each component of the military balance with a view to its safe dismantling. Each side has varied interests and weapons and we must learn to balance asymmetrical concessions.

Mr. Kahn, in what was probably one of the most lucid explanations he has ever given of his provocative views, set himself to paint a somber picture of current military potential and its possible—or, rather, probable—development. He envisaged cheap, plentiful nuclear weapons—perhaps five megatons for less than a million dollars, even from small-time production, and cheap ICBM's for a fraction of that. One consoling thought was the great deal of voluntary restraint which nations now are observing. None is pursuing the arms race with all its vigor. Few of the potential "*n*th countries" are engaged in active efforts to acquire nuclear weapons. The two superpowers are working toward unprovocative, stabilizing systems, and methods of control to guard against accident are within fairly easy reach.

Politically, Mr. Kahn was inclined to believe the Russians are susceptible to the same rational arguments for trying to make the military situation safer that we are. He felt that possibly they are not quite so aware of the catastrophic dimensions a general nuclear war would have, but "they are learning." For the moment, however, he thought the greatest possibilities for progress were in the nature of detailed agreements on particular stabilizing arrangements. The difficulties of negotiating a comprehensive treaty were such that he considered success unlikely except in an event on the order of the destruction of several cities. In such a case it might be possible to get assent to a treaty which could never be signed in cold blood. If this were to come to pass, it would be necessary to have a clear idea of a desirable treaty in advance so as to avoid prolonged negotiation in which the sense of urgency might wear off. It was for this reason that Mr. Kahn favored efforts to design comprehensive schemes of disarmament: to have them ready for use if a fleetingly favorable moment arrived.

Mr. Leghorn dwelt at considerable length on the constructive purposes to which armament expenditures might be put. It was in this

(Concluded on page 64)



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Disarmament Is Objective

(Concluded from page 62)

connection that he announced his new institution and a parallel plan for application of advanced management techniques to underdeveloped countries. Mr. Leghorn felt that in the present situation each super-power should retain an equal number of missiles as a guarantee against cheating by the other side. Because it would take more than one missile to eliminate one on the other side, no hope could be entertained of aggression with impunity. Possibilities of accident would still remain, however, and therefore, after the working of the control system had been tried and tested, the residual forces should be destroyed.

Transitional deterrence could remove Soviet fears that controls would render them vulnerable to surprise attack and the resources released from military uses would enable the Russians to remedy some of the poor social amenities which Mr. Leghorn believed their secrecy is also designed to conceal. For meeting threats of aggression with conventional arms, he envisaged a United Nations Security Force.

OXFORD-CAMBRIDGE UNIVERSITY'S Lacrosse Team came to M.I.T. the same weekend as British Prime Minister Macmillan and defeated the Institute's players 7 to 2 in a Centennial sports event.

Mr. Noel-Baker struck a completely different note from the other speakers and devoted himself almost entirely to an eloquent exhortation to disarm. Given the will, he declared, the technical difficulties would disappear. They were, he thought, far smaller than the difficulty of designing national forces. We had come, he asserted, to the realization that Woodrow Wilson and other founders of the League of Nations had been the true realists of their day. While he was not opposed to some measures of arms control, provided they were steps on the road to total disarmament, he deplored some of Mr. Kahn's proposals for minimizing the effects of a nuclear war as illusory and dangerous. Recalling the theme of the Centennial, Mr. Noel-Baker concluded by calling on scientists to destroy illusions and establish facts.

There was, unfortunately, no time for discussion, even among the panelists.

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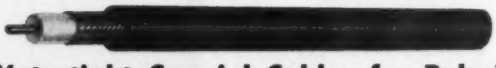

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W. W. K. FREEMAN	'22	R. H. ROBINS	'50	J. L. WAUTERS, JR.	'56
R. HARRIS	'37	F. J. BUMPUS	'51	R. L. CHILD	'57

Physics in the Future

(Concluded from page 50)

a further quickening of the pace. In the next few years, he anticipates "with some certainty, a great clarification in the field of weak interactions (of sub-nuclear particles) and with luck, the integration of various manifestations into a single unified theory." That theory will encompass the strong as well as the weak interactions and the role of magnetic, and possibly gravitational, fields in the interactions, he predicted.

Dr. Peierls foresaw much the same thing, but within the next 25 years, rather than the next few years. "On the front line of physics, we will be still looking for more particles, for other interactions of the particles at higher energies," he said. A unified theory may be forthcoming, but it will probably arrive in steps rather than in one bold stroke.

Dr. Feynman looked 100 years into the future. He suggested that the game will be over by then, that a final unified theory will have been formulated. It is inconceivable to him that the rate of discovery—three fundamental ones each 60 years—can continue. If it should, he said, "it would become boring."

Behind the advance into the microcosm of the nucleus, some of the panelists looked to biophysics and cosmology as exciting new areas in the physical sciences.

Sir John Cockcroft of Cambridge University in England, the 1961 Atoms-for-Peace Award winner, said radio astronomy may push back "still farther the boundaries of the observable universe." Its findings may settle the current argument over the origin of the universe: Did it begin with a "big bang" and is it continually expanding; or has it always been and always will be as it now is, in a steady state?

Sir John saw promise for further discovery in the new and more powerful particle accelerators (atom-smashers) that are a-building or contemplated. He posed a question to the panel: Is it worth the time, money, talent, and energy to build these new research tools? And different answers came from Dr. Yang and Dr. Feynman.

"Every time a machine is constructed in a new energy region, something exciting turns up," Dr. Yang said. But one cannot predict that this will continue. Perhaps new machines should wait until the data coming from present ones are digested by the theorists. Perhaps the new machines will only add more strange animals to the confusing number already found in the nuclear jungle, making the scene more bewildering instead of clarifying it.

"I want to be bewildered," countered Professor Feynman. The momentum of discovery must be maintained, he said, if physics is not to become impotent. True, the government which pays for the multi-million-dollar research tools must decide whether such "crazy arguments" by the physicists hold up against the competing social and economic needs of the nation. "But we should not give them arguments to use against us," he said.

In this most exciting time in the history of the physical sciences, the attitude of the panelists can perhaps best be summed up in the words of Professor Feynman: "I certainly don't want to retire from the field now."

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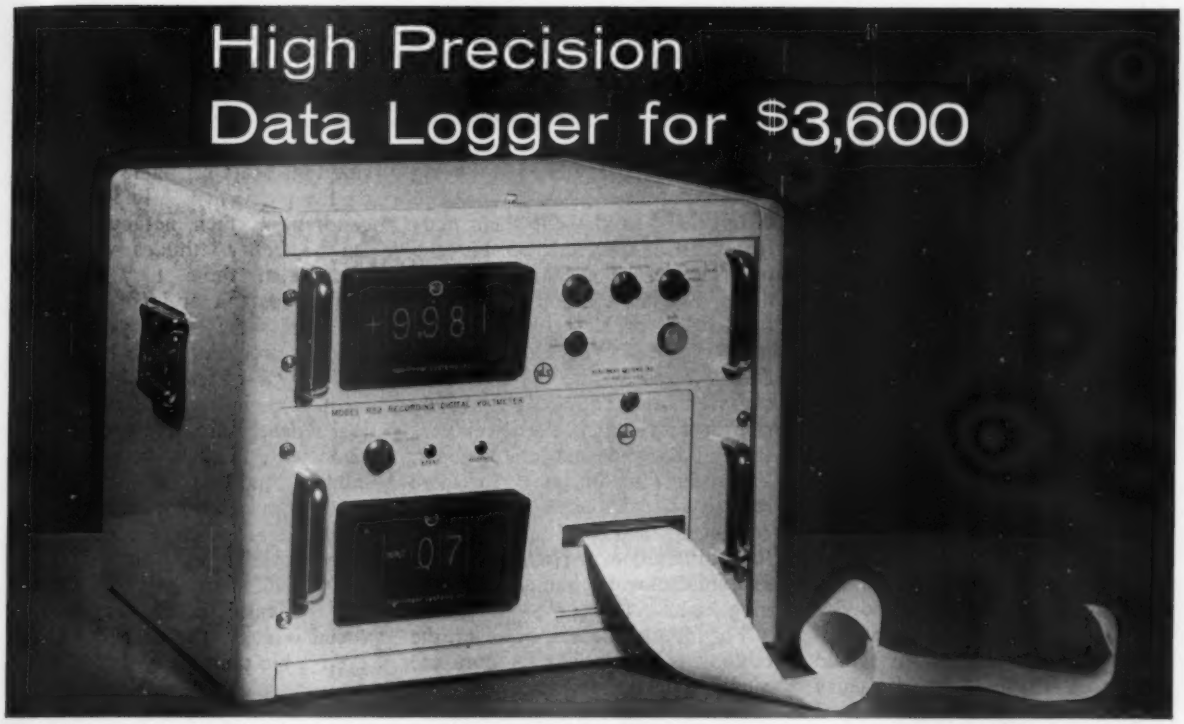

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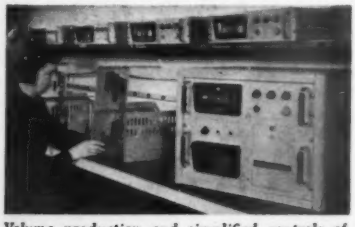

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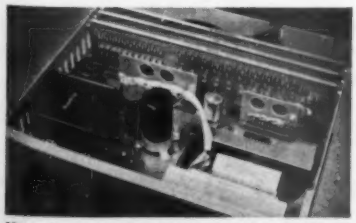

Note the compact, plug-in modular design of the scanner-printer section of the RS2.

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While utilizing many circuits field-tested for six years in thousands of NLS digital voltmeters, the RS2 has undergone extensive testing as a standard, complete system. It is delivered ready to use, without need for additional engineering or complex interconnections.

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Accuracy: ±0.01% of full scale on each range.

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Biology in the Future

(Concluded from page 51)

less ambitious than Professor Muller's. Eugenics seeks to improve man collectively as a race as well as individually. These are not always consistent goals, he said. Some data suggest that man as a race may be better off with a high degree of diversity in his genetic storeroom, to cope with new environments, enemies, or infections, as they arise. If this is true, he said, "we may have to abandon for the foreseeable future the utopian ambition of achieving a uniform population of excellent individuals whose progeny are uniformly as excellent as themselves."

In its place, he would substitute a program that he called "piecemeal genetical engineering . . . in which the welfare of the individual is the overriding consideration."

Thus Professor Medawar would seek to identify persons who carry dangerous genes. If they carry a disease-causing dominant gene, he would warn them that all their children will receive it. If they carry a recessive gene that is dangerous, he would tell them of the probable damage to their children if they were to marry someone who also carried the same recessive gene.

"The humane and rational way to treat the problem is to warn victims of the consequences of having children," rather than to attempt dictatorially to prevent their marriage. Thus warned, "no humane parent will take a chance," he believes. But this solution is not without its own problems, he admitted, for if the "bad" genes do not work their way out of the population by causing disease and death to the organism they afflict, they will very slowly become more frequent. "Thus the ultimate policy for these recessive diseases must be study and cure—and hopes of curing some such diseases, e.g., phenylketonuria and galactosaemia, are already running high."

For inborn diseases, however, the outlook is less bright. A cure for mongolism, for example, which is caused by a genetic accident, is difficult to see at present.

To Dr. Jonas E. Salk, Professor of Experimental Medicine at the University of Pittsburgh, "Man's most persistent and difficult biological problem (in the future) will not be his physical diseases, certainly not as in the past, but his relationship to himself and his fellow man."

The developer of the polio vaccine that bears his name speculated on the possibility of impressing on children, as their nervous systems mature, better attitudes, values and goals than those they now get through default or ignorance. New advances show that physical tolerance to foreign cells can be induced in embryos of animals before their birth. This is done before the natural defenses are developed. In the same way, it might be possible to induce "more desirable" human traits in man by way of his central nervous system, which does not mature until well after birth.

Dr. Salk saw need, too, for hybrid biological disciplines, such as social biology, psycho-biology, and even a bio-philosophy. Bio-philosophy, he said, would deal with "man's continued need for understanding the meaning of different manifestations of life, and for guiding his sense of responsibility in the evolutionary scheme."

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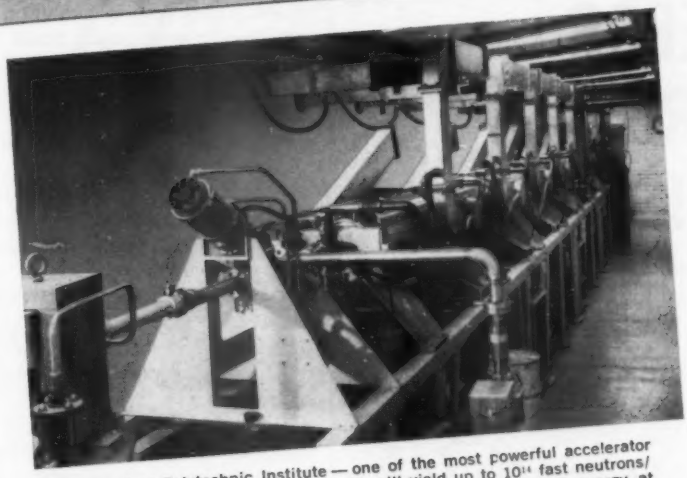

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High Energy Linacs

Today's rapid advances in particle accelerator technology are particularly illustrated by the microwave linear electron accelerator (linac). Spurred by experimental requirements for more intense bursts of high-energy electrons and neutrons contained within precise limits of time and space, High Voltage Engineering and Applied Radiation Corporation have sustained intensive development of linacs. The result has been consistent improvement in linac reliability, and a series of record-breaking machines for research.

Two research linacs of considerable sophistication are now being installed at Yale University and Rensselaer Polytechnic Institute physics departments. The Yale machine is a five-section L-band accelerator, producing 28 kw of average radiation power and peak energies of 77 Mev. It will be used in a broad physical research program with emphasis on nuclear cross-section investigations. RPI's accelerator is an unusually powerful neutron physics research tool.

The accelerators of the near-future are exemplified by the machine now being built for the U.S. National Bureau of Standards. This linac, designed to performance specified by the NBS, will produce electron beam peak energies up to 150 Mev. Its 40 kw power output at 100 Mev will be greater than any previously obtained from a linear accelerator and about 100,000 times that obtainable from existing NBS high energy accelerators.

Availability of the intense high energy electron beam — and of secondary radiations such as x-rays, positrons and neutrons — opens up new research areas for NBS scientists. The linac will be used in low temperature chemistry, solid state physics, metallurgical studies, neutron activation analysis, nuclear alignment studies and determination of radiation standards.

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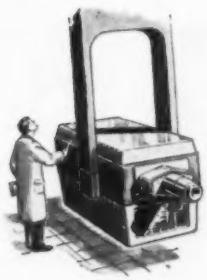

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Man's View of Himself

(Concluded from page 46)

finding important to man's world-view. Yet some of the findings in anthropology and in evolution have enriched, altered and made more subtle man's view of himself.

The physical sciences in this time have altered our understanding of ourselves as knowers, he said, in three ways:

¶ The breakdown of the attempt to attribute objective existence to matter by philosophical argument. This was accompanied by the necessity to establish the objectivity, the universality, the verifiability and the refutability of science. (Ambiguity is a necessary part of life—but not of physics.)

¶ The strange combination of freedom, choice, action and limitation in putting questions to nature. What we learn is limited by our ability to order thoughts, questions, and techniques. One of the troublesome aspects is this: Really to know something new we have to act, and when we act we change things; so we lose as well as gain.

¶ These conditions help to harmonize our cognitive life with our life of action—love, play, the arts. They have brought the intellectual life of science closer to the life of man. We cannot live without talking to each other about ends as well as means.

The science of the last 100 years, Dr. Oppenheimer ventured, has left intact these aspects of the humane image of man: We recognize man as a universal community, as a universal condition. We know man to be the possessor of great power and knowledge, but finite. We accept a sense of responsibility—of individual responsibility—to our history. In the sciences, he concluded, let us keep this in mind: We are responsible for man's history in the presence of dangers that are unprecedented —and not far from total.

Were these the words of optimists or of pessimists?

The thinkers disagreed. All great seers, Huxley observed, are profoundly pessimistic and infinitely optimistic at some time or other. And no one disputed Oppenheimer's dictum:

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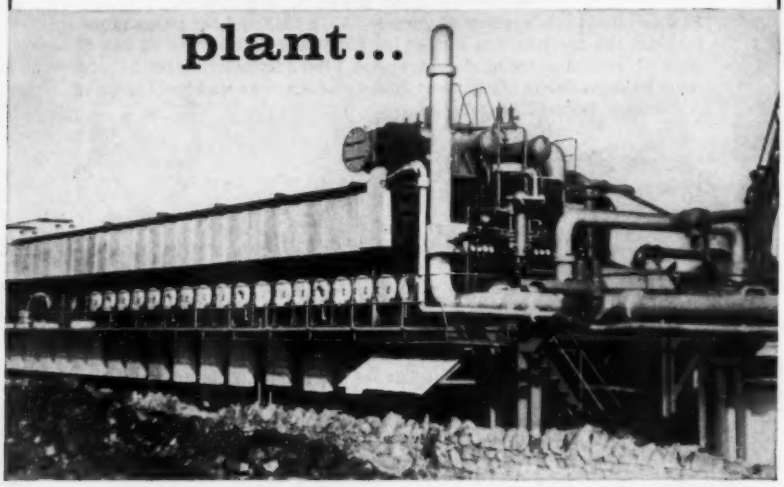

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The Arts in the Future

(Concluded from page 48)

he believes to be the main difference between the artist and the scientist. The scientist, he said, is concerned with Nature's nature; the artist is concerned with Man's nature. Professor Lippold then made several amusing observations about modern scientific theories and how the artist might approach them. Humility and an effort toward religion have been and will be the motives, he pointed out. By being alive and participating, we find ourselves in a religion. This religion has not been codified; therefore, we do not really know the future. He concluded by listing "people who have sought God." In the list were four names selected at random from the New York telephone directory.

The last speaker was the architect, Louis Kahn, and the points he developed were: The artist strives to make a dream a reality. The dream is unmeasurable; his pencil mark is measurable. Any system, therefore, makes a dream less; religion offers the best approach to realization. The scientist, also, starts with the unmeasurable, but he strives to lose it. In science, everything that is not measurable must be made measurable. The artist must realize, however, that science contributes a new sense of form and design; it offers many exciting outlets. It gives the architect, for instance, a better sense of order—order that is necessary so that our ways of life can be given expression.

In the short discussion that followed the formal talks, Professor Jones reminded the panel that the problem posed in the statement of the topic was answered only in part. More stress was given to the past and the present, he said, than to the future, and nothing was said about how the ordinary citizen can solve the dilemma of the conflict. To this, Professor Foss replied that the artist knows little of the spectator—he speaks to someone, but not to the masses—and this situation is not likely to change. Professor Jones suggested that the scientist is a servant to society and that the artist should try to reach this position. Professor Lippold disagreed. He maintained that the scientist really is not interested in serving the public but in self-enlightenment.

from A·SG *to* M.I.T.

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Industry in the Future

(Concluded from page 49)

a much broader role in virtually any kind of industry.

"The worker sees more and more that he can be a truly interchangeable part. Industry and education must go farther in teaching man how versatile he can be and how great a role he can play in strengthening his nation. Thinking in specialized terms must be abandoned." Skilled, but nonprofessional, workers of the future may derive major satisfactions from learning itself.

Dr. Land hoped for dramatically revised educational arrangements. Everyone should become associated with a university at 15 and maintain it for life. Diplomas should be granted as an epitaph, he suggested. "We are living in a language, talking ideas, using forms, of a generation that has passed. In our generation, we live in a world where science and technology have made it possible for characters like you and me to take the afternoon off just to bull."

He said that there "exists in all industry a magnificent, unarticulated conspiracy which says that I will employ three times as many people as I need if you will employ three times as many people as you need so we can support each others' consumers." It is great that so few have to work, but sad that there is so little truly important work provided for people to do. "When there isn't work to do, people will do work that isn't needed, because they want to work."

But there can be 10,000 new industries, all science based, involving continuous learning by those in them, Dr. Land continued. He looked forward to a life in industry embracing the entire population, divided into clusters of working groups made up of scientists, artists, technicians, and machinists, each working night and day on a vitally absorbing project to create something both useful and beautiful.

"If we can do this, we will have made America exportable. We will have something to offer—how men can live happily and effectively together." No tribal gods stand in the way if we find something that really needs doing. "All we have to do is to say, 'Let us, then.' "

Mr. Whyte foresaw a shift in the image of the manager. The concept that the administrator was a generalist, without a deep emotional commitment to the content of work, was overemphasized in the 1950's, he said, and there will be greater stress on the content in the future. President Kennedy's style of leadership may be contagious. In a sense, it is a throwback to an earlier style of leadership. There is ego, not self-effacement, in it. It is competitive. And the President evidences an absorbing interest in the content of work.

"How can a second-rate man who never has been emotionally involved in work make the vital choices?" Mr. Whyte asked. "We will make this change not because it is a good thing for industry necessarily, but because external challenges will force it."

NEXT MONTH: *The Review will bring you further reports on M.I.T. Centennial events in addition to the customary coverage of Commencement and Alumni Day activities.*

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Richard A. Faust, '56, Binghamton
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LEHIGH

Russell E. Hoaster, C.L.U., '31, San Antonio
Edward Billstein, Jr., '40, Atlanta
R. Lester Dodson, Jr., '44, East Orange

M. I. T.

Lyman L. Tremaine, C.L.U., '23, New York
Harold Goodheim, '39, San Francisco
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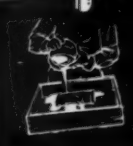

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A Magnificent Challenge

(Concluded from page 44)

The scientists and engineers of our generation face a magnificent challenge to join in interdisciplinary concert with the legal and political experts, and the social scientists, in meeting this crisis of our relations with the awakening nations. . . .

We do not have enough competent scientists and engineers to fill the many important posts in government, particularly at the policy level, requiring scientific and engineering training. We do not have enough scientists and engineers who have a deep understanding of their specialty and who have, in addition, the cast of mind, the motivation, and the breadth of understanding to serve effectively and to survive, in policy making, advisory, and administrative roles in the public service. We have hardly any scientists and engineers in politics. There should be scientists and engineers in Congress as there are now beginning to be in state legislatures and in other elective offices. Government in a technological society requires a reasonable compliment of scientists in the public arena if it is to deal wisely with all of the great policy matters arising out of science. . . .

In at least three American universities new programs have been started dealing with science and public policy. This past fall term I had the stimulating experience of giving a graduate seminar in this subject and subsequently I have met with seminar groups in two other institutions. This experience has convinced me that this new field is one of importance, and that there is a wealth of interesting material to be examined and codified, that we need a continuing study of the impact of science on government and on foreign affairs and the innovation this impact has caused. More importantly, it has revealed the new and invigorating winds blowing in political science and the cross-fertilization that is taking place between physical science and political science.

Centennial Publicity

AT ITS April meeting in the M.I.T. Faculty Club, the Alumni Council heard Dean John E. Burchard, '23, and Francis E. Wylie, Director of Public Relations, recall the backstage crises and humorous incidents during M.I.T.'s Centennial observance.

Clippings about Centennial events covered a whole wall. The Boston *Globe* issued a special Sunday supplement and vied with the other Boston papers in besieging M.I.T.'s Faculty and guests for interviews. More than 150 reporters, including many from overseas, spent the Centennial weekend at the Institute. Accommodations for the press included wire service in the basement of Kresge Auditorium and a balcony erected between two pillars of the Rockwell Cage for the television and film cameras. WGBH broadcast most of the proceedings, and repeated some programs.

Edwin D. Ryer, '20, reported that more than half a million dollars had been contributed to the Alumni Fund thus far this year, and Albert O. Wilson, Jr., '38, announced plans for Alumni Day on June 12. The Alumni Association's President, Clarence L. A. Wynd, '27, presided.

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Individuals Noteworthy

(Concluded from page 8)

Centennial Marshals

IN ADDITION to Chief Marshal David Allan Shepard, '26, the Centennial academic procession marshals were: *Marshall B. Dalton, '15,* the Corporation; *Patrick M. Hurley, '40, Carlton E. Tucker, '18,* and *Antoine M. Gaudin,* the Faculty; *George R. Harrison,* the Schools and Departments; *John T. Rule, 21,* the Students; *H. E. Lobdell, '17,* the Alumni; *Francis O. Schmitt, Martin J. Buerger, '24, Carl Overhage, Malcolm G. Kispert, '44,* and *Philip M. Morse,* the Delegates; *Carl F. Floe, '35,* the Centennial Institutions; *Joseph J. Snyder, '44,* the President, the Chairman of the Corporation, and the Guests of Honor.

Faculty Notes

JULE G. CHARNEY, Professor of Meteorology, has received the Symons Gold Medal of the Royal Meteorological Society of Great Britain . . . *Henry M. Stommel,* Professor of Oceanography, has been elected to the National Academy of Sciences . . . *Lockhart B. Rogers,* Professor of Chemistry, has been appointed to the advisory board of "Analytical Chemistry."

Guggenheim Fellows

MEMBERS of the M.I.T. Faculty receiving Guggenheim Fellowships this year are *Louis N. Howard,* for studies in geophysical fluid dynamics; *Arthur K. Kerman,* '53, for studies in the theory of nuclear structure; *Francis E. Low,* for study of the interactions of elementary particles by application of quantum field theory; *Thomas H. D. Mahoney,* for studies of Edmund Burke and the American Revolution.

Naval Operations Study

THE DIRECTOR of the M.I.T. Operations Evaluation Group, Dr. Jacinto Steinhardt, headed the United States delegation to a symposium at the Royal Naval College in Greenwich in April, at which naval requirements, tactics, and weapon systems for limited war were discussed.

Other representatives of the OEG present were Howard E. Higbie, Sidney K. Shear, and James K. Tyson, '41.

Stouffer Fellows

Two M.I.T. graduate students, Martin C. Anderson and Frank C. Colcord, Jr., will work in the Joint Center for Urban Studies of M.I.T. and Harvard next year on fellowships awarded to honor the late Professor Samuel Stouffer of Harvard. Mr. Anderson will study the role of private capital in urban renewal, and Mr. Colcord will study the politics of metropolitan transportation planning. Mr. Anderson is from Northboro, Mass., and Mr. Colcord from Long Island.

Woodrow Wilson Fellows

CHAIRMAN of one of 15 regional committees helping the Woodrow Wilson National Fellowship Foundation find talented young folk for college teaching is Professor E. Neal Hartley of M.I.T. His region includes Maine, New Hampshire, Vermont, Massachusetts and Quebec, New Brunswick, Prince Edward Island, Nova Scotia, and Newfoundland. Last year his fellowship committee handled 906 nominations and interviewed 346 candidates, of whom 165 received fellowships.

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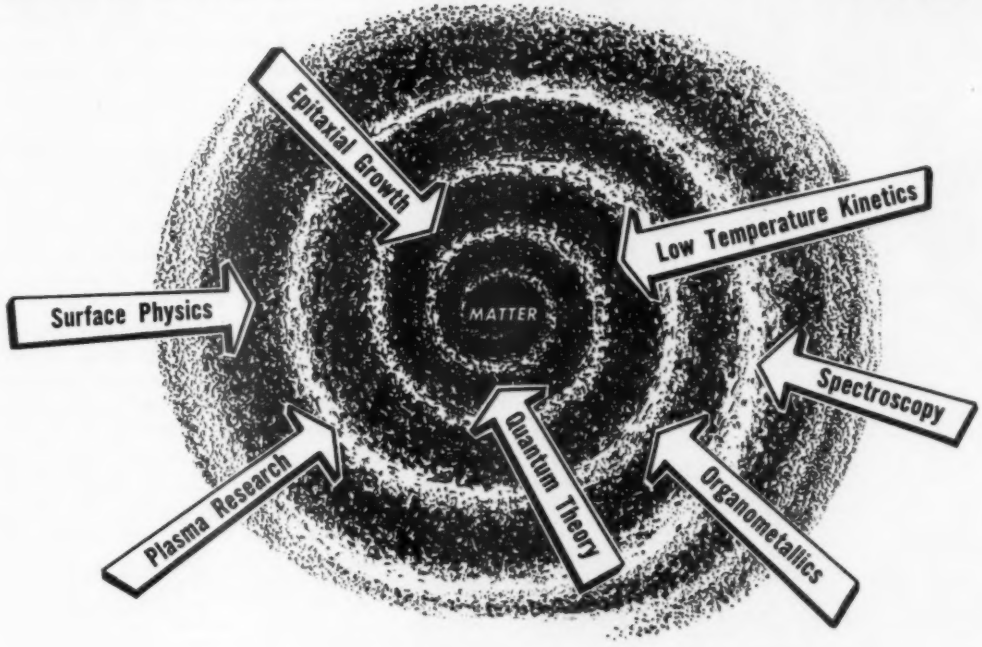

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Centennial Greetings to M.I.T.

(Continued from page 36)

the idea and the personality of its founder, President Rogers, who understood just as clearly as we do the new vision of a university based on the laws of nature and on their application to the needs of man. But it is a product too of the Faculty during the hundred years of its existence. We have had distinguished predecessors. We have seen several of our members step into the presidency of our own institution: Rogers first, who was professor as well as president, then Runkle, Crafts, Noyes ['86], as well as our present Julius Stratton ['23]. We have had others go on to distinguished service elsewhere: Charles Eliot as president of Harvard, Noyes as one of the leading spirits in the organization of the California Institute of Technology, Gilbert Lewis as a leading chemist at the University of California, Willis Whitney ['90] as organizer of the research laboratory of the General Electric Company, Vannevar Bush ['16] at the Carnegie Institution and in government service. But we have had other equally distinguished innovators. . . . They have been pioneers in laboratory instruction in science, in founding departments of electrical engineering, of chemical engineering, of aeronautical engineering, of many other newly developing fields. Men like Charlie Cross ['70], R. H. Richards ['68], W. T. Sedgwick, Jerome Hunsaker ['12], and W. K. Lewis ['05], to name only a few, have added continually to the ideas of the founder, and have carried the Institute forward . . .

(Concluded on page 82)

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Centennial Greetings to M.I.T.

(Concluded from page 80)

The Commonwealth of Massachusetts' greetings were conveyed by Governor John A. Volpe, who looked forward to continued reliance "on the creative genius of Tech in augmenting national security and in raising levels of living." Governor Volpe concluded:

At Technology's two hundredth anniversary, the world's most powerful magnet, which the Institute is now constructing, will have been overtaken by mightier mechanisms of electrical force. But if the future Institute holds fast to its cherished ideals, which are elements of its present grandeur and greatness—then, a century hence—the Massachusetts Institute of Technology, itself, will continue to be the magnet that draws mankind's abiding trust.

The American Universities' spokesman, Dr. Harlan Hatcher, President of the University of Michigan, said:

We salute the Massachusetts Institute of Technology especially because it has demonstrated with highest distinction how financial support from all sources—personal, foundation, private gifts, fees, government grants and contracts—can be joined in one endeavor; how a select student body can be advanced naturally into new frontiers; how a superior faculty can combine teaching, research, and application; how a major scientific institute can achieve leadership by joining social studies and the humanities into a common culture with the field of science and the industrial and business world.

Furthermore, the impressive attainments of the Massachusetts Institute of Technology on the most advanced level is one of our best reminders that, while the pressure of high school graduates on freshman entrance is massive and growing, there is an equally urgent but less well recognized pressure at the upper levels. This portion of our educational need is very expensive by undergraduate standards. It is critical in the effort of our nation for survival and for human betterment on an interlocking world scale.

Not many of our institutions are prepared to meet this need. Those that can must serve the world. Massachusetts Institute of Technology is such an institution, and receives the thanks and homage of us all. On the success of its work hangs the hope of the future for a rich and rewarding life for mankind.

And for the foreign universities, Professor John Fleetwood Baker of the University of Cambridge, hailed the Institute as an example for the world, in these words:

The society of the present depends for its power and prosperity, its leisure and its morale on the application and engineering of science. As yet the impact of the technological revolution on the individual, on society, and on government is imperfectly understood. The time has not yet come when all statesmen of the world can be expected to be well grounded in science and engineering; until they can, the lead given in your country by the Institute in providing the independent scientific support of government could well be followed by other countries with benefit to the whole world.

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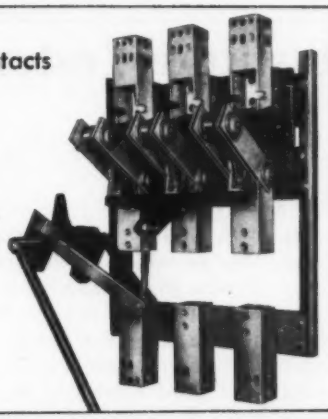

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Institute Yesteryears

25 Years Ago . . .

ON JUNE 8, 1936, occurred the Institute's second Alumni Day on which, as observed by The Review editors, "Nature smiled, and, as though in gracious response, this new type of reunion, begun only last year, seemed to have reached maturity. In the solidity and importance of its serious events and in the gaiety, warmth, and good fellowship of its lighter program, Alumni Day, 1936, seemed an adequate fulfillment of the hopes of those who championed the plan. To last year's committee who laid the foundation under the direction of Hamilton L. Wood, '17, and to this year's committee who so happily brought the plan to fulfillment under the direction of Harold B. Richmond, '14, is due an accolade from all those who cherish the Technology spirit and who wish to see its vivifying influence extended throughout our alumni body."

In the morning there was a "Transportaton Conference," presided over by J. Monroe Johnson, Assistant Secretary of Commerce, and participated in by four speakers as well as by Joseph B. Eastman, a member of the Interstate Commerce Commission.

Following luncheon in Du Pont Court, the new Sailing Pavilion was formally dedicated; and in the evening at Symphony Hall, 628 diners were present for the Alumni Association's 61st Annual Banquet.

¶ The following morning at Symphony Hall, commencement exercises marked the graduation of the Institute's 69th class. Of the total of 532 degrees awarded, 380 were bachelor's in the Class of 1936 and 152 went to candidates for advanced degrees, namely: 24 doctorates of philosophy and 17 of science, and 111 master's of science.

The academic procession was led by Alexander Macomber, '07, who had been the 35th President of the Alumni Association in 1928-1929; and next came President Karl T. Compton and the commencement speaker, Newton D. Baker, Secretary of War in the cabinet of Woodrow Wilson. At the head of the long procession of degree candidates marched John C. Austin, President of the Class of 1936, and its three elected marshals: Brenton W. Lowe, Fletcher P. Thornton, Jr., and Anton E. Hittl.

¶ Godfrey L. Cabot, '81, and William C. Potter, '97, were elected to life membership by the Institute Corporation at its June meeting.

¶ The Institute mourned the passing on June 3 of Arthur Amos Noyes, '86, who was its Acting President during 1907-1909, between the Pritchett and Maclaurin administrations; and who served as the 18th President of the Alumni Association in 1911.

Dr. Noyes joined the Institute staff upon graduation and, in 1899, was appointed professor of theoretical chemistry. In 1903 he founded, and for 17 years headed, the Research Laboratory of Physical Chemistry, which was the first research laboratory of M.I.T., and also the first in the United States to be devoted to physical chemistry.

50 Years Ago . . .

ON JUNE 5, 1911, President Richard C. Maclaurin was being congratulated upon the occasion of his 41st birthday.

¶ On June 6, at Huntington Hall in the Rogers Building on Boylston Street, there took place the commencement exercises of the Institute's 44th class. Of the total of 254 degrees awarded, 232 were bachelor's in the Class of 1911, and 20 were master's of science. There were also two doctorates: the first Ph.D. in Biology, to Eugene C. Howe, '11; and the first Sc.D. given by M.I.T., in Electrical Engineering, to Reginald L. Jones, '09.

¶ Mounting public interest in the Institute's proposed removal from Copley Square prompted the Boston *Evening Transcript* to note that there were "four sites under consideration, for each of which considerable favor is shown, as follows:

"In the Fenway, a large strip at the corner of Longwood Avenue and Avenue Louis Pasteur, opposite one side of the Harvard Medical School grounds and conveniently near other educational institutions, the Art Museum, hospitals, and where the Y.M.C.A. building is to be located;

"On the Charles River Basin at the corner of the Esplanade and Massachusetts Avenue, opposite Riverbank Court;

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(Concluded on page 86)

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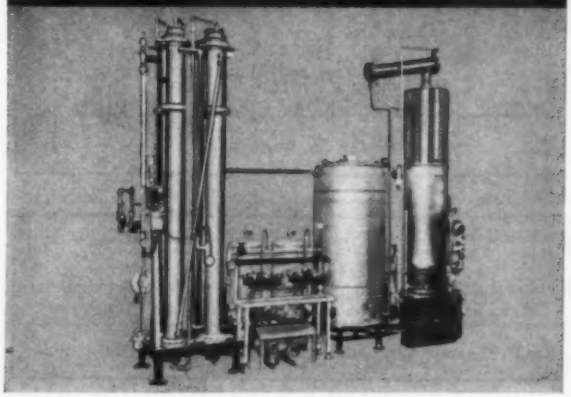

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Institute Yesteryears

(Concluded from page 84)

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75 Years Ago . . .

AS RECORDED in the Annual Report of President Francis Amasa Walker, "The Class of 1886 graduated on the 1st of June. Of the 62 students of the fourth year, who were candidates for the degree of bachelor of science, 59 were admitted to that grade, upon recommendation of the Faculty of the School of Industrial Science.

"The public exercises of the day were after the severe and simple form set by the first President of the Institute. The class thus graduating was one of exceptional strength of character and thoroughness of scholarship. There could be no higher example of what this school aims to effect than is afforded by the graduating theses of the Class of 1886, taken in connection with the records of its members during the four years of their stay among us."

Of the 59 degree recipients of the Institute's 19th class, 23, or 39 per cent, were graduated in mechanical engineering. The remaining 36 were divided by Course as follows: electrical engineering, 10; civil engineering, 9; mining engineering, 7; chemistry, 7; and architecture, biology, and general science, one apiece.

93 Years Ago . . .

IN JUNE, 1868, 13 members of the Institute's first class were graduated—one in mechanical engineering, five in civil and topographical engineering, six in geology and mining engineering, and one in science and literature. The form of their diplomas stated that each was a "Graduate of the Massachusetts Institute of Technology in the Department of . . . . . "; for not until three years later, was the designation "Bachelor of Science" adopted.

These fortunate 13 of the Class of 1868 were not subjected to formal commencement exercises; they obtained their diplomas simply by calling individually at the Institute office.

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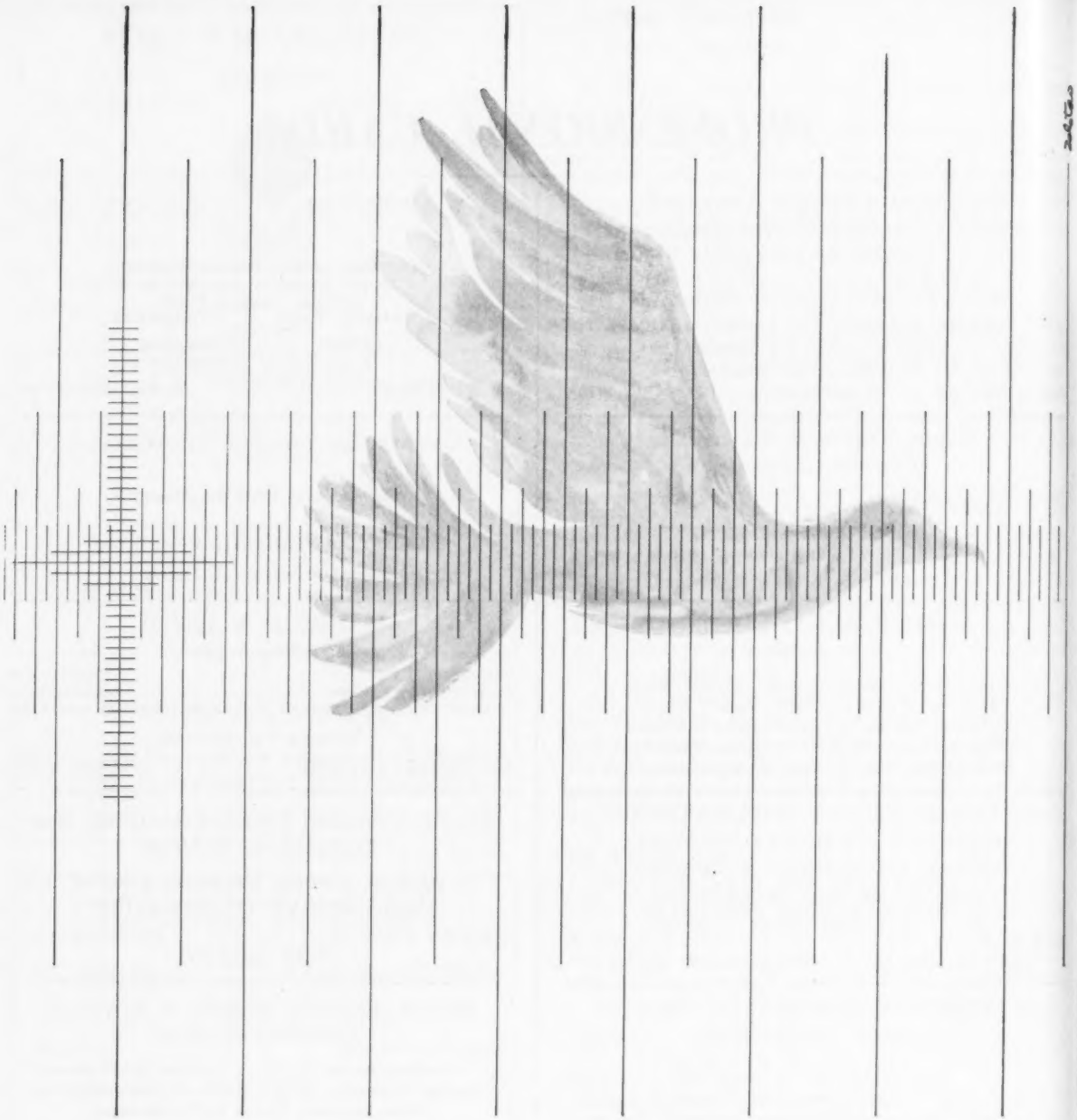

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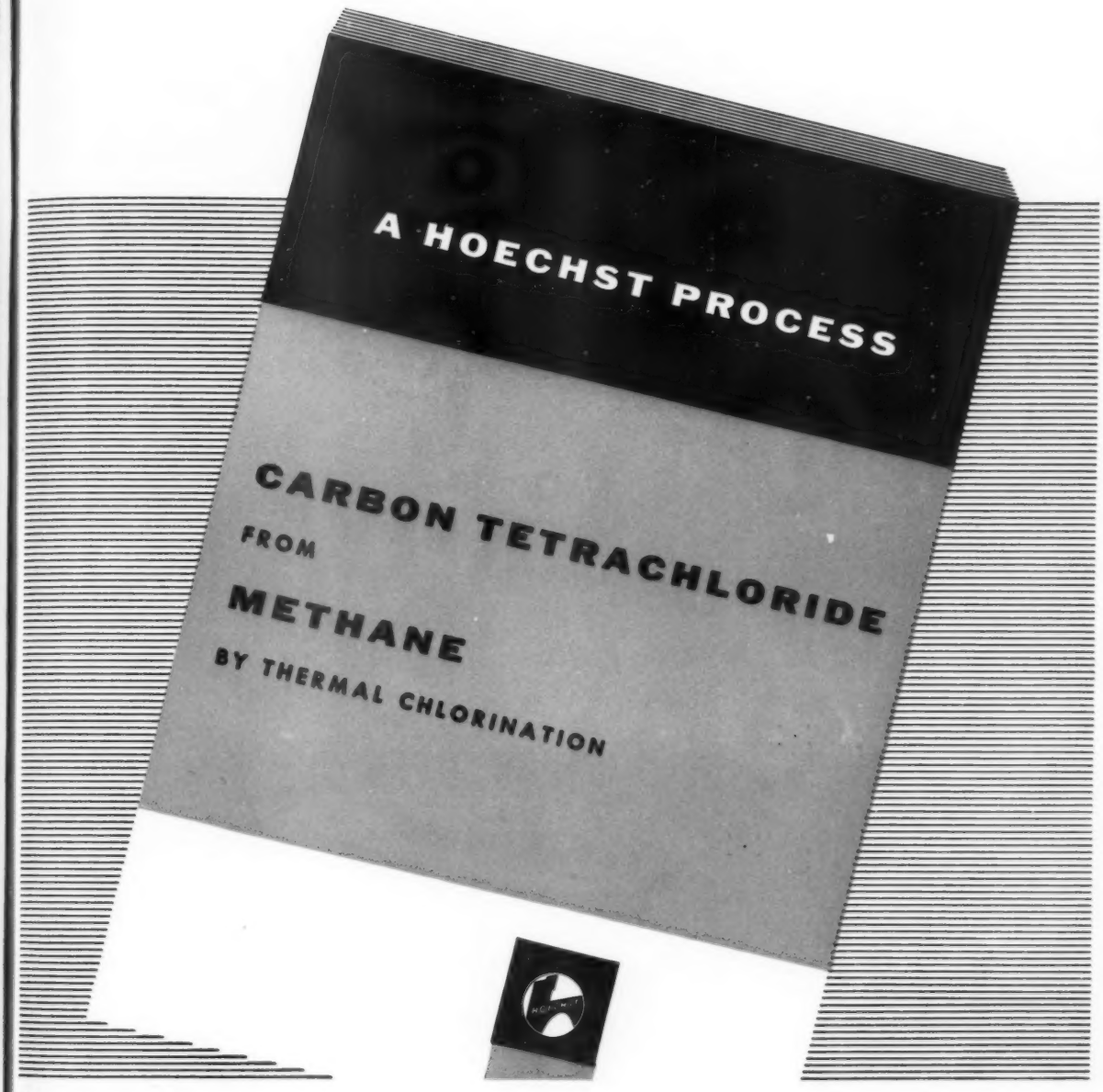

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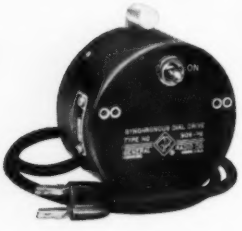

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